AeroSafety WORLD

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TIPPING POINT

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

SEPTEMBER 2011

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FRMS and You

I just left a big meeting at the International Civil Aviation Organization (ICAO) about the realities of implementing fatigue risk management systems (FRMS). First, I have to say that I continue to be amazed at ICAO's new sense of openness. I found myself surrounded by a mixture of industry leaders, regulators and scientists that never would have been allowed through those hallowed doors a few years ago. In addition, we had in our hands excellent guidance material that walked both the operator and the regulator through the process of FRMS implementation. It was especially exciting to see that the material carried the logos of ICAO, the International Air Transport Association and the International Federation of Air Line Pilots' Associations.

But this was not a party to celebrate a roll-out; this meeting addressed real implementation issues. It included a frank discussion about what could go wrong and where FRMS should not even be attempted. It is important to remember that FRMS is optional. It can be used as an airline's primary scheduling tool or as a tool to tweak existing flight-time and duty-time rules, or it can be left on the shelf. FRMS rests on a foundation of flight time and duty time rules. It does not replace them.

There are plenty of good reasons to implement an FRMS. It is a once-in-a-generation gift from science. When done right, FRMS relieves the company from arbitrary restrictions and gives crews the right rest at the right time. Pilots who have flown for companies that have adopted this approach say they wake up every day feeling better than they did when they were working for other airlines. FRMS can be one of those rare "win-win" programs.

What can go wrong? Unfortunately, quite a bit. A short-sighted labor leader could use it to justify unreasonable bargaining positions. A misguided operator, with a weak regulator, could use it to generate a data smoke screen to justify Draconian work rules. Or, a poorly protected system could allow a lot of very personal information to be disclosed in court in a way that could damage both the airline and its employees.

So here are some not-so-simple pre-conditions for a successful FRMS: First, there must be a real commitment to the program on the part of the company and the employees. They have to agree that they are going to do this thing in a way that makes life better, the company more efficient and operations safer; second, there has to be a regulator involved that is smart enough to know the difference between an FRMS and a fancy PowerPoint^{tm} presentation and confident enough to act on that knowledge; third, the effort must involve all the parties — if a union doesn't exist, there still must be a way to fully involve the crews, and every layer of management has to understand the program, including scheduling, human resources and any other concerned department; finally, there must be a plan to protect all this amazing data so it doesn't end up in the newspaper after the first operational incident or worker's disability claim.

Missing a few of those conditions? That isn't a shock. Conduct a frank and honest assessment and see what can be salvaged. Keep in mind this is not an "all or nothing" exercise. And remember to read the directions first.

Here's a link to the program description: <www2.icao.int/en/FatigueManagement/Pages/FatigueManagementTools.aspx>.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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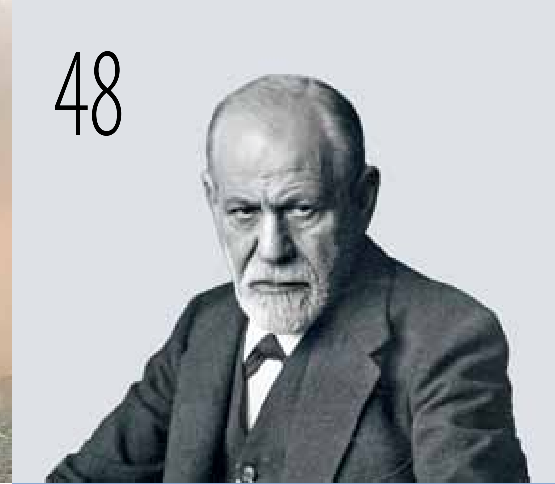

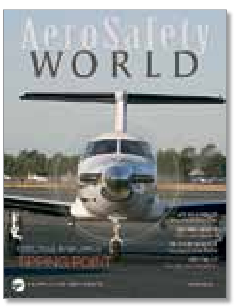

About the Cover
Ice blocked fuel flow from Pilatus PC-12's left wing tanks.
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HOW'S IT Going?

According to the responses to a survey we recently conducted, it is going pretty good, with some areas of concern. By "it," I mean the state of safety culture in the aviation industry.

The survey was intended primarily to gather information about what our readers like and don't like about *AeroSafety World* so that we can (a), improve the publication; and (b), show prospective advertisers that this is a credible, widely read safety publication. That last part — our hope going into the exercise — happily was confirmed; it seems as if most of you are very positive about what we are doing, with, as always, room for improvement. If you are a prospective advertiser, we'll gladly share the survey results with you.

However, we also tossed in a couple of safety culture questions seeking opinions about changes over the past few years, and sent the survey to two groups — to our digital edition subscribers, more than 11,000, and to people on our FSF members contact list, a bit over 3,000. We got more than 1,000 responses; not every question was answered by every respondent, explaining why you won't be able to add numbers to make 100 percent.

When we asked, are more people in your company actively involved in safety activities?, a very vigorous 81.1 percent of subscribers said yes, and an even happier 86.6 percent of the member list agreed. However, 9.7 percent of subscribers told us fewer people are involved; only 3.4 percent of the FSF member list agreed with that notion.

We asked if there were more cross-functional safety committees. Some 42 percent of the subscribers said yes, but 52.9 percent of the FSF members agreed, showing that someone has been paying attention. However, 13.1 percent of subscribers and 9.2 percent of members said that recently more safety decisions are being made by a single person, a fairly disturbing statistic.

It is easier to report safety problems and deviations for 52.6 percent of our subscribers and an even better 65 percent of FSF members, but more difficult for 6.8 percent of subscribers and 4 percent of FSF members.

An interesting switch in tone was revealed by responses to the question: Has regulator involvement recently been more helpful or less helpful? Among the subscribers, 30.4 percent said regulators have been more helpful, while only 24.4 percent of FSF members agreed. This approval gap widened even further when the question was if regulator involvement has become less helpful. Some 13.8 percent of subscribers believed this, while 23.5 percent of FSF members said this is true. I can only guess why these numbers broke down this way by pointing out that 18.4 percent of FSF member responses came from executive-level people, a much larger number than the 8.4 percent of executive-level subscribers. Perhaps — and this is just a guess — more interaction between regulators and executives produces a less-rosy outlook on the process.

I think we can take comfort in the fact that there is growth in the kinds of attitudes and practices that have been found to help reduce the risk of accidents, but we must also remain concerned that despite overwhelming evidence, some people and institutions are backsliding into old and counterproductive ways. Safety, it is said, is not a destination but a journey, and some have decided to take a disturbingly different route.

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.

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Pre-Eminence

I just finished your editorial [*ASW*, 7/11, p. 5] and must commend you on your exceptional leadership of *ASW* the past five years. Your editorial staff is excellent, and I can assure you — from my viewpoint as a reader — that the publishing expertise is excellent as well. No apologies are necessary for a printing schedule that relies partly on safety-related events, which never occur at a convenient time. Also, the transformation of the magazine has been excellent and its presentation is surely bound to attract further advertising, which I have learned through *Professional Pilot* is always a publication's lifeblood, and the daily battle to retain it month after month never-ending.

ASW remains the pre-eminent magazine for aviation safety, and your efforts are to be commended. Likewise, your staff, which I have had the pleasure to work with on numerous occasions, has that rare ability to make statistics-filled accident reports an interesting read.

Thank you for allowing me to contribute and work with the Foundation and *ASW*; it is by far my most rewarding effort expended in this business.

David M. Bjellos
Aviation Manager, Florida Crystals

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. 12–17 ➤ Como Gestionar e Investigar Accidentes de Aviación. SMS Seguridad Aérea 360º. Toluca, México. Ing. Victor Manuel del Castillo, <info@factoreshumanos.com>, <www.factoreshumanos.com>, +(52 722) 273.0488.

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.

SEPT. 15 ➤ 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.

SEPT. 19–20 ➤ Third Global Aviation Safety Conference for Humanitarian Air Service. World Food Programme. Acapulco, Mexico. <www.wfp.org>, +971 6.557.4799.

SEPT. 20–21 ➤ FAA Safety Management System (SMS) Gap Analysis Conference. Center for Aviation Safety Research, Saint Louis University. St. Louis. Shelly Reichert, <mreiche3@slu.edu>, <www.cvent.com/events/safety-management-system-gap-analysis-conference/event-summary-7d15ecf69ee6413f82afb33edaa0565a.aspx>, +1 314.977.8725.

SEPT. 20–21 ➤ Asia Pacific Airline Training Symposium. Halldale Media Group. Bangkok. <halldale.com/apats-2011/overview>, +44 (0)1252 532000; +1 407.322.5605.

SEPT. 21–22 ➤ Part 145 Maintenance Organization Approvals. Avisa/CAAi. Manchester, England. <www.avisa-ltd.com/training>, +44 (0)845 0344477.

SEPT. 26 ➤ Aircraft Composite Repair Management Forum. Aviation Week. Madrid, Spain. Juliet Trew, <juliet_trew@aviationweek.com>, <www.aviationweek.com/events/current/compos/index.htm>, +44 (0)20 7176 6233.

SEPT. 26–29 ➤ Aircraft Rescue and Fire Fighting Working Group (ARFFWG) Annual Conference. ARFFWG. Orlando, Florida, U.S. <info@arffwg.org>, <www.arffwg.org/2009-conference>, 866.475.7363, +1 817.409.1100.

SEPT. 26–30 ➤ SMS Principles. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <www.mitremai.org>, +1 703.983.5617.

SEPT. 26–OCT. 5 ➤ Theory and Application. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <www.mitremai.org>, +1 703.983.5617.

SEPT. 27–28 ➤ ICAO Asia and Pacific Regional Accident Investigation Workshop. International Civil Aviation Organization and Air Accident Investigation Bureau of Singapore. Singapore. Brian Siow Yao, <bryan_siow@mot.gov.sg>, +65 6542 2394.

SEPT. 27–29 ➤ Aviation Safety Management Systems Training. Webeventsolutions. Montreal. Luc Tousignant, <luc@webeventsolutions.com>, <www.webeventsolutions.com/aviation/sms>, +1 514.831.8744.

SEPT. 29 ➤ SM4 Human Factors Seminar. Global Aerospace. Kansas City, Missouri, U.S. Suzanne Keneally, <skeneally@global-aero.com>, <www.global-aero.com>, +1 973.490.8588.

SEPT. 29–30 ➤ Flight Recorder Training. International Civil Aviation Organization and Air Accident Investigation Bureau of Singapore. Singapore. Brian Siow Yao, <bryan_siow@mot.gov.sg>, +65 6542 2394.

OCT. 3–7 ➤ Operational Risk Management. Southern California Safety Institute. San Pedro, California, U.S. <registrar@scsi-inc.com>, <www.scsi-inc.com/ORM.php>, 800.545.3766; +1 310.517.8844, ext. 104.

OCT. 3–14 ➤ Aircraft Accident Investigation. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/aai.htm>, +1 310.342.1349.

OCT. 4–5 ➤ Airport Pavement Maintenance and Evaluation Workshop. American Association of Airport Executives and Pavement Consultants Inc. Denver. Brian Snyder, <brian.snyder@aaae.org>, <events.aaae.org/sites/111007>, +1 703.824.0500, ext. 174.

OCT. 4–5 ➤ Staying in Control: Loss-of-Control Prevention. European Aviation Safety Agency. Cologne, Germany. <bit.ly/pSnoOX>.

OCT. 5–6 ➤ International Winter Operations Conference: Safety Is No Secret. Air Canada Pilots Association/Association des pilotes d'Air Canada. Montreal. Capt. Barry Wiszniowski, <bwiszniowski@acpa.ca>, <www.winterops.ca>, +1 905.678.9008/800.634.0944, ext. 225.

OCT. 6–7 ➤ Part 145 Maintenance Organization Approvals. Avisa/CAAi. Glasgow, Scotland. <www.avisa-ltd.com/training>, +44 (0)845 0344477.

OCT. 10–12 ➤ NBAA 64th Annual Meeting and Convention. National Business Aviation Association. Las Vegas. Donna Raphael, <draphael@nbaa.org>, <www.nbaa.org/events/amc/2011>, +1 202.478.7760.

OCT. 10–11 ➤ Laser Interference in Aviation. Eurocontrol. Brussels. Marie-Josée Fernandes Bouca, <www.eurocontrol.int/events/seminar-laser-interference-aviation>, +32 2 729 3960.

OCT. 10–12 ➤ Aviation Safety Management. ScandiAvia. Stockholm. Morten Kjellesvig, <morten@scandiavia.net>, <www.scandiavia.net/index.php/web/index_kurs/C6>, +47 91 18 41 82 (mobile).

OCT. 17–19 ➤ Accident/Incident Response Preparedness. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/aip.htm>, +1 310.342.1349.

OCT. 31–NOV. 3 ➤ 64th annual International Air Safety Seminar. Flight Safety Foundation. Singapore. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/aviation-safety-seminars/international-air-safety-seminar>, +1 703.739.6700, ext. 101.

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

Safety News

Accessible Oxygen

Oxygen mask hoses in airliner cockpits should be made longer to ensure that pilots have full access to emergency equipment located in the cockpit, the U.S. National Transportation Safety Board (NTSB) says.

In a safety recommendation letter to the U.S. Federal Aviation Administration (FAA), the NTSB cited the circumstances surrounding the May 16, 2010, fire in the windshield heat terminal connection in the cockpit of a United Airlines Boeing 757-200 during a flight from New York to Los Angeles. The flight crew diverted to Washington Dulles International Airport in Chantilly, Virginia. None of the 112 people in the airplane was injured.

The NTSB said that the probable cause was the ignition of a power terminal on the captain's windshield because of a loose electrical connection. The captain told NTSB accident investigators that he had donned his oxygen mask and smoke goggles because of the acrid odor in the cockpit; soon afterward, he left his seat "because the flames were in front of him and he needed to immediately reach the fire extinguisher" on the back wall of the cockpit, the NTSB said.

© Lvco99/Flickr

"The captain stated that, as he moved toward the fire extinguisher, his oxygen mask and smoke goggles were 'torn off' because he had reached the end of the hose attached to the oxygen mask," the NTSB said.

He put the mask and goggles back on, discharged the fire extinguisher and moved toward the cockpit door to pick up a second fire extinguisher from a flight attendant. As he did, the mask and goggles came off again.

The NTSB said that it "is concerned that the length of the hose attached to the captain's oxygen mask was insufficient to allow him access to needed emergency equipment located in the cockpit without having the mask inadvertently removed from his face. As a result, the captain was needlessly exposed to smoke and fumes."

The Air Line Pilots Association, International (ALPA) had made a similar suggestion to the FAA in 2007. ALPA noted that the response from the FAA Seattle Aircraft Certification Office was that oxygen masks were intended primarily for use during a decompression, not while fighting an in-flight fire.

The NTSB recognized the need for portable breathing equipment in fighting a cabin fire but added that it might be "of limited use while fighting an in-cockpit fire when the oxygen masks are available and likely already donned."

In its safety recommendation letter, the NTSB also called on the FAA to "provide clear guidance … concerning the type of breathing equipment to wear when combating a cockpit fire" — that is, whether oxygen masks or portable protective breathing equipment would be preferred.

A third recommendation asked the FAA to amend advisory circulars to specify that cockpit fire extinguishers must be within the reach of at least one flight crewmember while oxygen masks are in use.

Tiger Suspension Ends

Tiger Airways Australia has resumed operations after a suspension of more than one month by the Civil Aviation Safety Authority of Australia (CASA), which said it would continue monitoring the airline's operations.

CASA suspended Tiger Airways' operations July 2, citing a "serious and imminent risk to air safety," and lifted the suspension Aug. 10, with the condition that Tiger Airways comply with CASA requirements for pilot training, proficiency, rostering and fatigue management.

Other conditions involved the currency and revision of operations manuals, appointment of personnel to key positions and amendments to the airline's safety management system.

"Tiger Airways Australia was required to demonstrate it had complied with the necessary safety requirements before it was permitted to resume operations," CASA said.

CASA Director of Aviation Safety John McCormick said that Tiger Airways had shown that it could comply

Jimmy Harris/Wikimedia

with the conditions for its air operator's certificate and "meet the necessary safety requirements."

Fuel Findings

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The practice of some low-cost carriers of consistently avoiding the carriage of extra fuel could create situations that limit a captain's decision-making options and lead to the impression among pilots that the use of marginal fuel is normal, the International Federation of Air Line Pilots' Associations (IFALPA) says.

The organization said its survey of 132 airline pilots about their employers' fuel-planning policies found that 40 percent of the pilots wanted more authority in determining how much fuel to load for specific flights.

About one-third of the respondents said that they were aware of landings by their company's pilots with fuel that amounted to less than the "final reserve."

"Landing with astonishingly small amounts of fuel occurs on long-range flights, as well as on short-haul flights," IFALPA said in a briefing leaflet on its survey. Despite such "extreme examples," the leaflet said, "overwhelmingly, the practice of good airmanship is widespread."

The leaflet noted "tremendous differences" in operators' policies and speculated that a number of fuel incidents might go unreported, however.

New Rules

New regulations are in effect throughout Europe for the licensing and medical certification of air traffic controllers.

The regulations, developed by the European Aviation Safety Agency (EASA), establish uniform requirements for controllers and require continent-wide recognition of controller licenses, ratings, language endorsements and medical certificates.

Controllers with licenses issued in accordance with the new regulations will be qualified to work in all EASA member states.

EASA Executive Director Patrick Goudou said that the implementation of a single set of regulations for controller licensing "will make an important contribution to the achievement of a high and uniform level of safety across Europe."

New Warnings on Fuel Additives

The U.S. National Transportation Safety Board (NTSB), citing the 2009 crash of a Pilatus PC-12/45 that killed the pilot and all 13 passengers, is asking regulators to require more stringent warnings to pilots about the need for fuel additives, including fuel system icing inhibitors (p. 14).

Recommendations to the European Aviation Safety Agency (EASA) and the U.S. Federal Aviation Administration (FAA) call for the two regulators to amend certification requirements for aircraft that require fuel system icing inhibitors and other fuel additives "so that those limitations are highlighted by a warning in the limitations section of the airplane flight manual." Other recommendations would apply that requirement to aircraft that already are in service.

The NTSB also called on the regulators to require that the same warnings be placed on a fuel filler placard.

An additional recommendation, issued only to the FAA, called on the agency to "issue guidance on fuel system icing prevention that includes pilot precautions and procedures to avoid fuel system icing problems aboard turbine engine–powered aircraft and describes the possible consequences of failing to use a fuel system icing inhibitor, if required by the airplane flight manual, especially during operations at high altitudes and in cold temperatures."

The airplane had been en route from Oroville, California, U.S., to Bozeman, Montana, when the pilot diverted to Butte, Montana. The airplane crashed west of Runway 33 in Butte.

In related action, the accident prompted the FAA to publish a proposed clarification of its seat belt and seating requirements for U.S. Federal Aviation Regulations Part 91 general aviation aircraft to specify that a seat belt and/or seat may be used by more than one person only if the seat belt is approved for such use, the "structural strength requirements for the seat are not exceeded" and the seat usage is in compliance with the airplane flight manual.

The accident airplane's 13 passengers — six adults and seven children — shared nine seats, and the NTSB said that evidence indicated that four of the children were either unrestrained or improperly restrained.

Sbscottw/Wikipedia

Battery Policy Called Unacceptable

The International Federation of Air Line Pilots' Associations (IFALPA) has denounced policies that continue to exempt air cargo shipments of lithium batteries from most provisions regulating the handling of dangerous goods.

The batteries have been linked to more than 40 reported incidents of "smoke, fire, extreme heat or explosion in air transport," IFALPA said.

There are two major types of lithium batteries: lithium ion batteries, which usually are rechargeable and used in such devices as laptop computers, cell phones and portable music players; and lithium metal batteries, non-rechargeable batteries used in cameras, flashlights and automatic external defibrillators.

Testing has shown that a fire involving lithium ion batteries "will easily propagate through the entire shipment of batteries." Other tests have determined that the Halon fire suppression systems used in many aircraft cargo holds are unable to control a lithium metal battery fire, IFALPA said.

IFALPA noted that when lithium batteries are shipped as air cargo, they are not subject to many of the technical instructions developed by the International Civil Aviation Organization (ICAO) for dangerous goods shipments, including requirements for a dangerous goods label to be placed on the package. The ICAO instructions also include a call for the pilot-in-command to be informed of the presence of the battery shipment in the aircraft and for shippers to receive training in dangerous goods regulations.

The instructions should be revised, IFALPA said, "to protect passengers, flight crew and the aircraft from the risk of a fire caused or made worse by the shipment of lithium batteries as cargo."

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Antonov An-12s Grounded

Rostransnadzor, the Russian agency supervising transportation, has suspended flights by the 12 Antonov An-12 airplanes operated by six airlines within the Russian Federation.


Juergen Lehle/Wikimedia

The agency said the suspension would remain in effect until the airlines reduce the risks of operating the An-12s through actions taken in accordance with safety management systems.

The suspension followed the Aug. 9 fatal crash of an Avis-Amur An-12 — described as the oldest airplane in the Russian commercial fleet — as the crew attempted to return to Magadan, Russia, because of a fuel leak and an engine fire. All 11 people in the airplane for the cargo flight were killed and the airplane was destroyed in the crash.

In Other News …

The International Civil Aviation Organization has signed an agreement with the International Federation of Freight Forwarders Associations to conduct a joint training program on the transportation of **dangerous goods** by air. … **Deborah A.P. Hersman** has been sworn in for a second term as chairman of the U.S. National Transportation Safety Board. … The Civil Aviation Safety Authority of Australia has updated its guidelines for aviation operations during **volcanic ash** events. The guidance, based on updated material from the International Civil Aviation Organization, says aircraft should not operate in areas of medium or high ash contamination but operations may be permitted in areas of low-level contamination, as long as a safety risk assessment is conducted first.

Compiled and edited by Linda Werfelman.


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Tipping Point

BY MARK LACAGNINA

An icing-induced fuel imbalance triggered a loss of control.

The outside air was cold enough to cause water dissolved in the Pilatus PC-12/45's Jet-A fuel to form ice crystals that accumulated on the main fuel filter and built up sufficiently on components in the left wing tanks to block the flow of fuel from the tanks. The airplane became increasingly left-wing-heavy as excess fuel returned by the engine was added to the fuel trapped in the left tanks while the right tanks continued feeding the engine.

The pilot pressed ahead toward the planned destination until he apparently realized that his efforts to balance the fuel and to correct the low-fuel-pressure condition were not working. He diverted the flight to an alternate airport but lost control of the airplane while maneuvering to land. The PC-12 crashed near the runway, killing all 14 people aboard.

In its final report on the March 22, 2009, accident, the U.S. National Transportation Safety Board (NTSB) said that the probable causes were "the pilot's failure to ensure that a fuel system

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icing inhibitor was added to the fuel [and] his failure to take appropriate remedial actions after a low-fuel-pressure state (resulting from icing within the fuel system) and a later fuel imbalance developed."

The accident airplane was operated by a company owned by three partners. Media reports said that the passengers on the accident flight were family members en route to a resort near Bozeman, Montana, U.S., for a week of skiing.

The company's contract pilot, 65, held an airline transport pilot license and had 8,840 flight hours, including 1,760 hours in PC-12s. He had retired from the U.S. Air Force as a transport and instructor pilot in 1972, and had flown for several airlines and as a PC-12 pilot for an air ambulance operator before being hired by the company in 2002.

A former chief pilot for the air ambulance operator told investigators that the pilot was "extremely knowledgeable" about the airplane. A PC-12 training center instructor said that the pilot had demonstrated "superb" judgment and a "very high level" of competence.

PC-12 Fuel System

A brief description of the airplane's fuel system might aid in understanding the circumstances that led to the accident.

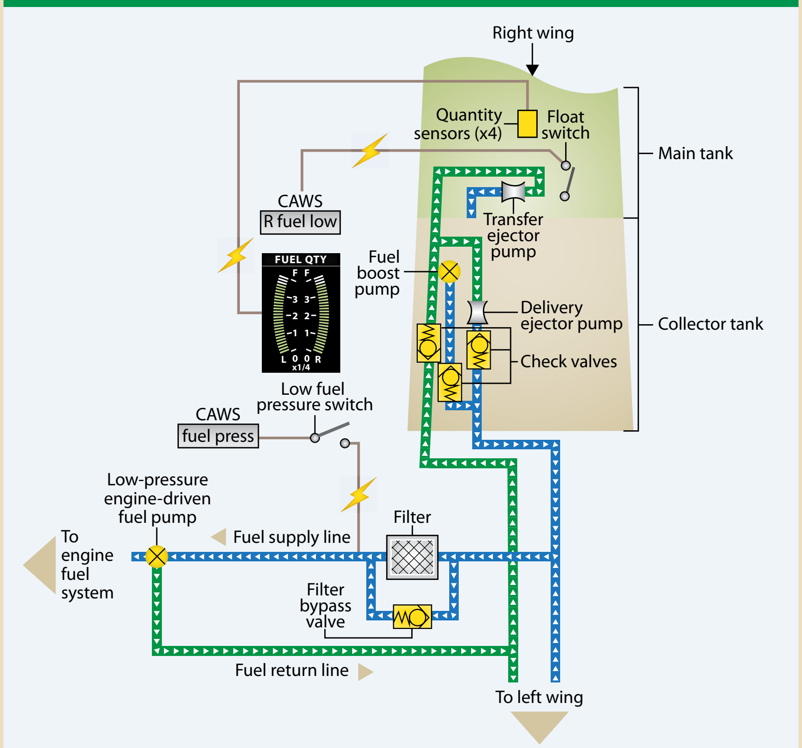
The system holds a maximum of 2,704 lb (1,227 kg) of usable fuel in a main tank and a collector tank in each wing (Figure 1). Ejector pumps transfer fuel from the wing tanks to the engine. By design, more fuel is supplied to the engine than is necessary for combustion, and excess fuel is sent back to the tanks via return lines.

Electric boost pumps are activated automatically or manually to correct a low-fuel-pressure condition, typically caused by filter blockage or the failure of an ejector pump or the engine-driven fuel pump, or to balance the fuel in the wing tanks.

Fuel quantity is indicated by two vertical arcs, each comprising 28 "bars," or liquid crystal display segments. Each bar represents about 48 lb (22 kg) of fuel. The PC-12 airplane flight manual (AFM) states that if an imbalance of three bars is indicated and cannot be corrected, the pilot should "land as soon as practical."

Of particular note is that the AFM requires an icing inhibitor to be blended with the fuel

PC-12/45 Fuel System



CAWS = central advisory and warning system

Source: U.S. National Transportation Safety Board

Figure 1

Pilatus PC-12/45

© Jerry Search/Airliners.net

Swiss aircraft manufacturer Pilatus announced plans to develop a pressurized, single-turboprop utility airplane in 1989. A prototype PC-12 flew two years later. The PC-12/45, so designated for its increased maximum takeoff/landing weight of 4.5 tonnes (4,500 kg, 9,900 lb), was introduced in 1996 and received U.S. Federal Aviation Administration approval for commercial operation under instrument flight rules the next year.

The airplane has two pilot seats and eight passenger seats in standard configuration; certification for single-pilot operation allows a ninth passenger to occupy the copilot's seat. The Pratt & Whitney Canada PT6A-67B engine is flat-rated at 895 kW (1,200 shp) for takeoff and 746 kW (1,000 shp) for climb, and drives an aluminum four-blade Hartzell propeller.

Maximum rate of climb at sea level is 1,680 fpm. Maximum operating altitude is 30,000 ft. Maximum cruise speed is 270 kt at 25,000 ft. Maximum range is 2,261 nm (4,187 km). Stall speeds are 65 kt in landing configuration and 92 kt clean.

The PC-12/45 was replaced in 2006 by the PC-12/47, which has a higher maximum takeoff weight (4,740 kg, 10,450 lb) and winglet and aileron modifications designed to improve handling.

Source: *Jane's All the World's Aircraft*

for all operations in ambient temperatures below freezing.[1]

"On a standard day, the temperature is 0 degrees C [32 degrees F] at 7,500 ft, so most PC-12 flights would require the use of an [icing inhibitor]," the report said. "All jet fuels contain trace amounts of water, and a fuel system icing inhibitor lowers the freezing point of water to minus 46 degrees C [minus 51 degrees F] to prevent the water from turning into ice crystals, which can block a fuel line or filter."

The report noted, however, that refueling records for the accident airplane indicated that the pilot did not always ensure that an icing inhibitor was added. He did not request an icing inhibitor when the airplane was refueled at its home base in Redlands, California, the day before the accident.

Too Many People

The accident flight from Redlands to Bozeman comprised three legs, with stops in Vacaville, California, and Oroville, California, to pick up passengers.

The pilot departed from Redlands at 0742 local time. The average outside temperature recorded by the engine trend-monitoring system was minus 24 degrees C (minus 11 degrees F) at the cruise altitudes, Flight Level (FL) 260 (approximately 26,000 ft) and FL 220.

After arriving in Vacaville at 0930, the pilot used the airport's self-service facility to refuel the PC-12. Investigators found no evidence that an icing inhibitor was blended with the fuel.

The instrument flight rules (IFR) flight plan filed by the pilot for the next leg of the trip listed five occupants. However, there were 10 people aboard when the airplane departed from Vacaville at 1020. The average outside air temperature at the cruise altitude, 6,000 ft, was minus 4 degrees C (25 degrees F).

Four more passengers boarded the airplane at Oroville. Although the pilot's IFR flight plan listed nine people, seven adults and seven children ranging in age from 1 to 9 were aboard the 10-seat airplane when it departed for the flight to Bozeman at 1210 local time.

"At least four of the seven children on board the airplane were not restrained or were improperly restrained," the report said. "After the accident, one of the owners of the airplane (who organized the flights) stated that the airplane had carried the same number of adult and child passengers on previous flights."

The limitations section of the PC-12 AFM specifies that the maximum number of passengers is nine. The report noted, however, that the U.S. Federal Aviation Administration (FAA) allows a child under age 2 to be held on an adult's lap. The FAA also permits two people to occupy one seat in a noncommercial airplane if their total weight does not exceed 170 lb (77 kg) and they can be secured properly by the seat belt.

There was no evidence that the pilot performed weight-and-balance computations for any leg of the trip. Investigators estimated that the airplane was within center-of-gravity limits for all three legs but was over the maximum takeoff weight by 432 lb (196 kg) on departure from Vacaville and by 572 lb (259 kg) on departure from Oroville.

The flight plan showed an estimated time en route of 2.5 hours with 3.5 hours of fuel aboard for the leg from Oroville to Bozeman. Shortly after departure, the pilot was cleared by air traffic control (ATC) to navigate directly to Bozeman.

The average outside air temperature at the cruise altitude, FL 250, was minus 40 degrees C. Data recorded by the PC-12's central advisory and warning system (CAWS) showed that the boost pump in the left collector tank operated nearly continuously beginning about an hour after departure, a sign that ice was restricting the flow of fuel from the left tanks, causing a fuel imbalance and contributing to the low-fuel-pressure condition.

The boost pump in the right collector tank also operated intermittently in response to the low-fuel-pressure condition caused by the partial blockage of the filter and by the decreasing flow of fuel from the left tanks.

At 1335, or about an hour and 15 minutes after departure, the fuel quantity indicator showed a three-bar differential. "About 1 hour 21 minutes into the flight, the fuel supplied to the airplane's engine was being drawn solely from the right fuel tanks by the right fuel boost pump, and the left-wing-heavy fuel imbalance continued to increase," the report said.

Despite the low-fuel-pressure condition, however, the engine operated normally throughout the flight.

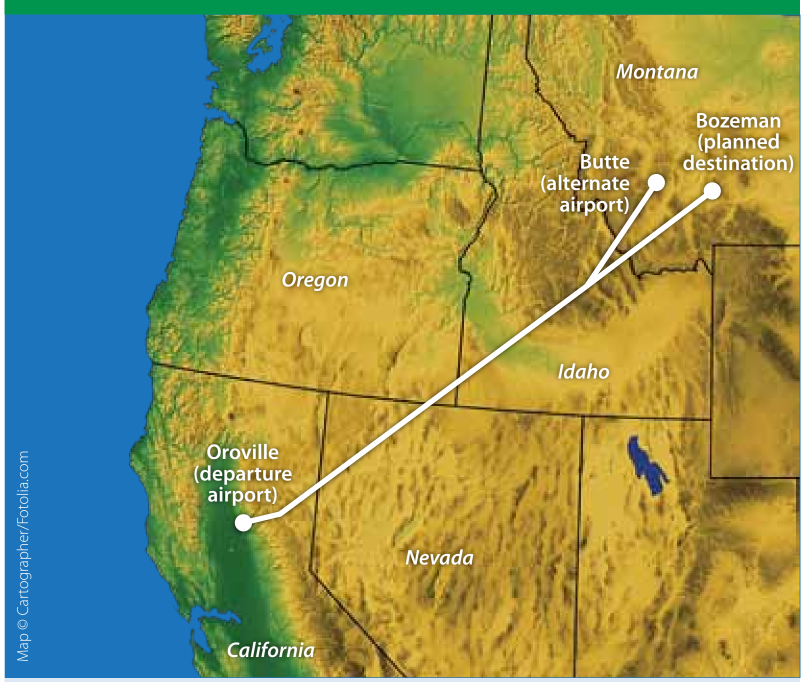
Self-Induced Pressure

The pilot had told a training center instructor that he never felt company pressure to fly in unsafe conditions. NTSB concluded that his decision to continue toward Bozeman rather than to land at one of several suitable alternate airports that were available as the fuel imbalance worsened likely was influenced by self-induced pressure to avoid inconvenience to his passengers.

However, about two hours into the flight, the pilot likely "recognized the magnitude of the situation" and requested clearance from ATC to divert to Butte, Montana (Figure 2). He did not provide a reason for the request, and ATC did not question it.

Investigators were unable to determine why the pilot chose to land at Butte, rather than at a closer alternate airport. Moreover, at this point, the distances to Bozeman and to Butte were similar, and the weather conditions were nearly identical, with 10 mi (16 km) visibility, a broken ceiling at about 6,000 ft and winds from the northwest at 8 kt.

Flight Path



Source: U.S. National Transportation Safety Board

Figure 2

Soon after ATC approved the request to divert to Butte, the pilot asked for clearance to descend. The controller issued the altimeter setting for Butte and cleared the pilot to descend at his discretion to 14,000 ft. The report noted that the minimum IFR altitude for the area was 13,100 ft.[2]

About 10 minutes later, at 1422, the pilot was cleared to descend to 13,000 ft and to report when he had the airport in sight. The pilot acknowledged the instruction, requested a lower altitude and was cleared to descend to 12,200 ft, the minimum IFR altitude.

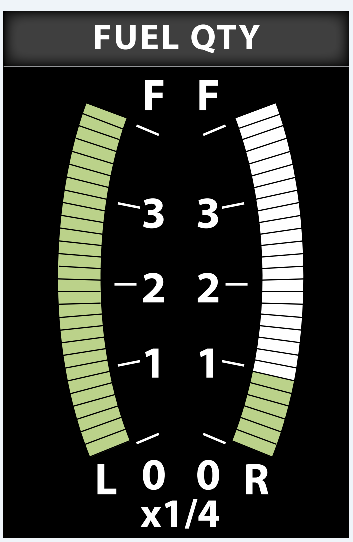
'Extreme' Imbalance

Shortly thereafter, however, the airplane descended below the assigned altitude. At this point, the fuel quantity indicator showed a 22-bar differential, which was characterized by the report as an "extreme" imbalance (Figure 3).

At 1427, the controller advised the pilot that the airport was 12 nm (22 km) ahead and asked if he had the field in sight. The pilot responded, "Yeah, as soon as we get past one more cloud."

Recorded ATC radar data showed that the PC-12 was at 11,100 ft and 8 nm (15 km) southwest of the airport when the pilot reported that he had the field in sight and canceled his IFR clearance.

Fuel Indication on Approach



Source: U.S. National Transportation Safety Board

Figure 3

The Butte airport is an uncontrolled field located in a valley at 5,550 ft in mountainous terrain. The pilot reported on the common traffic advisory frequency that he intended to land on Runway 33. "The last recorded radar target, at 1430:25, showed that the airplane was at an altitude of 9,100 ft (3,550 ft above ground level) and about 1.8 nm [3.3 km] southwest of the Runway 33 threshold," the report said.

A witness said that as the airplane neared the runway, it appeared to be much too high to land. The witness said that the airplane then flew northwest, away from the runway, entered a steep left turn about 300 ft above the ground, pitched nose-down and descended rapidly.

The PC-12 crashed and burned in a cemetery about 2,100 ft (640 m) west of the approach end of the runway. CAWS data indicated that the left wing tanks were filled to capacity and that the right wings tanks contained only 66 lb (30 kg) of fuel on impact.

Investigators were unable to identify the source of the restriction to the flow of fuel from the left tanks. "Ice accumulation in the fuel system … could degrade the performance of many fuel system components, including the fuel boost pumps and valves," the report said.

"If the pilot had added [an ice inhibitor] to the fuel for the flights on the day of the accident, as required, the ice accumulation in the fuel system would have been avoided, and a left-wing-heavy fuel imbalance would not have developed."

The accident investigation generated several recommendations (see p. 11). Among them was that the FAA and the European Aviation Safety Agency should raise pilot awareness about manufacturers' requirements to blend an icing inhibitor with jet fuel and about the potential consequences of noncompliance.

This article is based on NTSB Accident Report NTSB/AAR-11/05, "Loss of Control While Maneuvering; Pilatus PC-12/45, N128CM; Butte, Montana; March 22, 2009." The report is available at <ntsb.gov/investigations/reports.html>.

Notes

1. The most common fuel system icing inhibitor is diethylene glycol monomethyl ether, known by its trade name, Prist.
2. The FAA defines *minimum IFR altitude* as "1,000 ft [or 2,000 ft in mountainous areas] above the highest obstacle within a horizontal distance of 4 nm [7 km] from the course to be flown."

Waiting

BY LINDA WERFELMAN

FAA postpones a final rule on duty time limits and rest requirements for airline pilots.

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Issuance of a new package of flight and duty time limitations and rest requirements for U.S. airline flight crewmembers — years in the making — has been delayed again. The projected date for release of the final rule describing the new requirements is now Nov. 22.

The U.S. Federal Aviation Administration (FAA) previously had planned to issue the final rule in early August. An FAA spokeswoman offered no details on the reasons for the delay, other than to say that the rule is "still under executive review."

Under the proposed rule, U.S. Federal Aviation Regulations Part 121 air carrier pilots would be required to have a minimum of nine hours of rest before reporting for duty — in most cases, one more hour than currently required (Table 1, p. 22). Maximum allowable duty times and flight times would vary — depending on the number of pilots in the crew, the start time, number of flight segments and the existence of aircraft rest facilities. In most cases, however, maximum flight and duty times would be shorter than the currently allowable periods.

The Air Line Pilots Association, International (ALPA) said that the delay in issuing new regulations endangers airline safety.

"The White House has stalled a historic, safety-based regulatory effort to create modern duty and rest regulations for U.S. airline pilots," said Lee Moak, an airline captain and the

Proposed Flight Duty Periods

	Maximum Flight Duty Period (Hours) Based on Number of Flight Segments[2]						
Start Time[1]	1	2	3	4	5	6	7+
0000-0359	9	9	9	9	9	9	9
0400-0459	10	10	9	9	9	9	9
0500-0559	11	11	11	11	10	9.5	9
0600-0659	12	12	12	12	11.5	11	10.5
0700-1259	13	13	13	13	12.5	12	11
1300-1659	12	12	12	12	11.5	11	10.5
1700-2159	11	11	10	10.0	9.5	9	9
2200-2259	10.5	10.5	9.5	9.5	9	9	9
2300-2359	9.5	9.5	9	9	9	9	9

Notes

1. Local time at the flight crewmember's home base or at a location in another time zone to which the crewmember has become acclimated. The maximum flight periods are reduced by 30 minutes for a crewmember who has not become acclimated to the time zone.
2. Applies to unaugmented flight crews.

Source: U.S. Federal Aviation Administration

Table 1

president of ALPA. "With each hour of delay beyond the deadline, airline passengers and crews are needlessly put at risk when we know that the solution to addressing pilot fatigue lies in science-based regulations that apply to all types of flying."

In a mid-August speech to the ALPA Air Safety Forum, Deborah A.P. Hersman, chairman of the U.S. National Transportation Safety Board (NTSB), agreed, voicing frustration with the "slow rolling" of the publication of the final rule. The NTSB has for years included the mitigation of pilot fatigue on its Most Wanted List of transportation safety improvements.

When the notice of proposed rule making was published in September 2010, the FAA said the proposed changes would "sufficiently accommodate the vast majority" of flight operations while also "reducing the risk of pilot error from fatigue leading to accidents."

The rule-making effort was begun in June 2009 — about 15 years after a previous FAA attempt to introduce new requirements was met with opposition from the airlines because of the associated cost and the scarcity of supporting data, and ultimately shelved.

Publication of the new proposed rule in the *Federal Register* on Sept. 14, 2010, generated similar objections, voiced in many of the 2,000 public comments submitted before the comment period ended six weeks later.

Opposition came from the airline industry in general, and cargo and charter operators — including charter operators that carry military troops and military cargo — in particular.

The Air Transport Association (ATA) said that, although it supports the establishment of duty and rest requirements that are developed from science-based safety and operational data, it opposes the proposed rule because, in drafting it, the FAA "went well beyond what current scientific research and operational data can support and added many other measures and requirements that … are based on individual judgments driven by extraneous considerations, including perceptions about the political environment and what is acceptable."

These measures include strict limits on daily flight times and limits on any extension of the flight duty periods, the ATA said.

The ATA also said that its calculations indicated that implementation of the proposed rule would cost nearly $20 billion over 10 years, well above the FAA's "incomplete" estimate of $1.3 billion over the same time period.

The National Air Carrier Association, which represents charter operators, said, in its 2010 response to the proposed rule, that the FAA had "failed to consider the unique nature of the operations of nonscheduled carriers" and that the proposal would have a "disproportionately large, if not disastrous" effect on its members' small businesses.

The Cargo Airline Association had similar complaints, citing the FAA's disregard of "substantial operating differences between industry segments that require different methods of mitigating fatigue." The agency's proposal would "seriously impede the operating flexibility of the all-cargo carriers and, even where operations remain feasible, will dramatically increase costs," the association said.

© Chris Sorensen Photography

FRMS has not yet made major inroads in aviation maintenance.

Finding a Foothold

BY LINDA WERFELMAN

Aviation maintenance organizations have been slow to implement formal fatigue risk management systems (FRMS), despite their unique opportunities to employ some of the most effective types of fatigue countermeasures, according to a report by the U.S. Federal Aviation Administration (FAA) Civil Aerospace Medical Institute.[1]

Aviation maintenance personnel work in conditions that are conducive to fatigue, often at night and with unregulated duty hours, the report said.

Rudy Quevedo, Flight Safety Foundation deputy director of technical programs and a member of the FAA Maintenance Fatigue Working Group, said airline mergers and general economic upheaval have resulted in increased stress, longer work hours and fewer opportunities for sleep for many maintenance technicians, some of whom have taken second jobs.

Quevedo, who began his career as a mechanic for Eastern Airlines, said that at times, his shift extended for 24 hours or longer, and that, when necessary, he and his colleagues took short naps, although the company had no official napping policy.

The FAA report noted that many maintenance tasks — "especially those involving intense visual attention, communication or a heavy reliance on memory" — are especially susceptible to fatigue's effects.

FRMS usually addresses the threat of falling asleep during a "continuous-control task" such as piloting an aircraft. However, falling asleep is not the primary hazard facing aviation maintenance personnel, the report said. Instead, the greatest threat involves fatigue-impaired mental functioning and the possibility that it will lead to maintenance errors.

"This distinction, while seemingly trivial, has important implications for fatigue risk management in aviation maintenance," the report said, adding that it follows that the methods and goals of a maintenance-oriented FRMS will differ from those of a flight crew FRMS.

For example, because maintenance tasks typically are "self-paced rather than externally paced," a maintenance technician who recognizes that he or she is fatigued "may be able to pause a task, trade speed for accuracy or repeat a step, as necessary," the report said.

Falling asleep is not the primary hazard facing aviation maintenance personnel.

Maintenance personnel also may, in some cases, have opportunities to modify task performance, perhaps by introducing the use of task cards or operational/functional checks or performing demanding tasks at times of day when fatigue is less likely, the report said.

In addition, the report said, maintenance personnel usually do not travel across time zones and therefore do not experience jet lag and travel-related disruption of their circadian rhythms — two problems that often plague pilots and flight attendants.

As a result, the report added, maintenance organizations may be able to employ a greater number of solutions to their fatigue problems.

The report cited three objectives of fatigue risk management: reducing fatigue, reducing the number of fatigue-related errors or identifying the errors and correcting them, and limiting the harm caused by errors.

Flexibility is crucial, Quevedo said, adding that an absolute limit on the number of hours worked might not be the best option for either an employer that has extra maintenance work that must be completed on time or employees who understand how to adjust their task performance to compensate for fatigue.

"Eventually, there'll have to be FRMS," he said, adding that it would be especially useful "when it's not business as usual."

'52 Days Straight'

Methods of reducing fatigue include limiting an employee's hours of service (HOS). U.S. Federal Aviation Regulations say only that maintenance technicians working on Part 121 air carrier aircraft must be off duty for "at least 24 consecutive hours during any seven consecutive days, or the equivalent thereof, within any one calendar month."

"In effect," the report said, "a person could work up to 52 days straight, in a period of two consecutive months, and still be in compliance with the regulation."

Only a few countries apply specific limits, the report said. For example:

- The New Zealand Civil Aviation Authority says that maintenance personnel must have had at least eight hours off duty before performing work and at least four 24-hour periods off in the preceding month.
- The Civil Aviation Administration of China says maintenance personnel may work no more than eight hours a day and 40 hours a week. Under special circumstances, they may work as long as 11 hours a day, but monthly overtime may not exceed 36 hours.

The Civil Aviation Safety Authority of Australia, under regulations that took effect in June, does not limit work hours but instead "makes it an offense for a maintenance organization to permit a maintainer who is significantly impaired by fatigue or a psychoactive substance to carry out maintenance on an airline aircraft," the report said.

Best practices guidelines developed for the U.K. Civil Aviation Authority (U.K. CAA) — which does not itself prescribe work limits — call for 12-hour shifts that, with overtime, should be extended to no longer than a total of 13 hours, with a work break every four hours. Technicians should have at least 11 hours off between shifts, and they should be informed of their work schedules a month in advance.[2]

While not incorporated into U.K. CAA regulations, the guidelines were included in an agency advisory document for Part 145 operators and in guidance issued by the International Civil Aviation Organization.

Scientific Scheduling

Another method of reducing fatigue is scientific scheduling, which incorporates a software modeling system to estimate the level of fatigue likely to result from a specific scheduling pattern.

"Software models … can take into account circadian variations in alertness and sleep obtained, to produce an estimate of the fatigue level that may result from a particular shift pattern," the report said. "When used as scheduling tools, software models have the advantage of offering greater flexibility than HOS limits."

The report cited the Fatigue Audit InterDyne (FAID) model as an example, noting that it considers employee work and break times for a seven-day period and assigns a fatigue score of between zero and 140. Typically, employees who score less than 80 are "generally safe" to perform their jobs, the report said, but scores of more than 80 may indicate an "unsafe condition."

The report added, however, that research by the U.S. Federal Railroad Administration has indicated that scores as low as 60 may indicate fatigue-related risks.

Fatigue models generally have been used in flight crew scheduling, but one airline, which the report did not name, also has used FAID to evaluate maintenance work schedules and to help in schedule design.

The report also cited planned naps of 20 to 40 minutes as a key mitigation for fighting fatigue but acknowledged that "napping as a fatigue countermeasure in maintenance may face resistance from airlines and regulators."

In addition, the report suggested that providing employees with educational material about fatigue and acceptable countermeasures is one of only a few methods by which an organization can influence employees to reduce fatigue that results from lifestyle choices.

The European Aviation Safety Agency includes fatigue among the topics that should be covered in maintenance human factors training, and some civil aviation authorities, including Transport Canada, the U.K. CAA and the FAA, have published educational material on fatigue — some of it aimed not only at maintenance personnel but also at their supervisors, non-maintenance co-workers, and family members.

Some FRMS guidelines call for workers to take "fatigue leave" if they believe they are too fatigued to perform their duties, but the report conceded that the concept may not be readily accepted.

"Organizations need to weigh the potential disruption caused by an unplanned absence with the potential harm that could result when an employee reports for duty impaired," the report said.

A 'Second Line of Defense'

Because fatigue cannot be eliminated, the report recommended "a second line of defense, with the objective of reducing the probability of error among fatigued workers."

First, workers are taught to monitor their level of fatigue, overcoming the inherent inaccuracy of self-perception by using a fatigue rating scale (Table 1) or psychomotor performance tests that can be installed on hand-held devices or smartphones. The report noted that various alertness monitoring devices now being used in the trucking industry may eventually be incorporated into an FRMS.

To reduce levels of fatigue, work breaks — especially those that include a brief walk — can provide temporary relief, as can exposure to fresh air or cool, dry air, the report said, citing

Karolinska Sleepiness Scale

1	2	3	4	5	6	7	8	9
Very alert		Alert, normal level		Neither alert or sleepy		Sleepy, but no effort to keep awake		Very sleepy, great effort to keep awake

Source: Akerstedt, T.; Gillberg, M. "Subjective and Objective Sleepiness in the Active Individual." *International Journal of Neuroscience*, Volume 52 (1990): 29–37.

Table 1

several earlier studies. Bright light also can reduce fatigue and fatigue-related errors, and caffeine, if used according to a precise schedule, can reduce fatigue for about two hours, studies have shown.

Task-Based Action

Other efforts to reduce fatigue-related errors emphasize changing some aspect of the assigned task — an area that has received relatively little attention.

"Task-based approaches are based on the idea that maintenance tasks vary along a continuum, from tasks that are highly susceptible to fatigue to those that are less susceptible," the report said. "Task-based approaches … can involve two complementary strategies: changing *when* the task is performed and changing *how* it is performed."

Research has identified the types of tasks most prone to fatigue-related errors, including tasks that are monotonous or very familiar. Others that are highly susceptible are inspection tasks, tasks that require "intense, continuous concentration," those performed in a darkened environment and those in which "incorrect performance is not immediately obvious," the report said.

Most maintenance organizations do not consider the fatigue-susceptibility of a task when they develop work schedules, but individual maintenance technicians sometimes have "informal norms concerning the time of day at which tasks are performed," the report said, noting that their procedures may involve performing the most challenging tasks at the beginning of a work shift.

"In most large organizations, [maintenance personnel] have limited control over the timing of tasks throughout their shift, yet crew leads, foremen or planning personnel may have some influence on the time of day at which certain tasks are performed," the report said. "It is critical, therefore, that such personnel have an awareness of the effects of fatigue on human performance."

Some tasks can be "fatigue-proofed," or modified to reduce the likelihood of fatigue-related errors or to increase the likelihood that such an error will be detected," the report said, noting that Transport Canada has recommended that the following fatigue-proofing strategies be used when performing tasks that are susceptible to fatigue:

- Work under close supervision;
- Work in pairs or teams;
- Rotate tasks;
- Use checklists;
- Use experienced personnel to provide support for new personnel; and,
- Conduct briefings when shifts turn over.

Recommendations from other sources call for formalized self-checks, operational or functional checks, or independent inspections for tasks that are especially susceptible to fatigue or those that have been performed incorrectly in the past because of fatigue. Other research calls for rested personnel to check work that has been performed during the window of circadian low — between 0300 and 0600 local time.

Minimizing the Harm

Recognizing that fatigue-related errors occur despite efforts to prevent them, the report said that a "final line of defense" should limit the damage that results from these errors.

"Harm minimization differs from the interventions described in the preceding sections, as the focus is on the severity of the error's consequences, rather than the probability of error," the report said. "Harm minimization in the context of maintenance fatigue involves keeping the most safety-critical tasks out of the hands of the most fatigued people."

The report said that, for example, work on flight control systems would not be assigned to maintenance personnel during their circadian low point, but they would instead be given other, less critical tasks. "This approach does not prevent maintainers from making a fatigue-related error on whatever task they are assigned but reduces the likely consequences of that error."

The report said that although, in many cases, HOS limits and scientific software scheduling models have been used separately and viewed as competing methods of addressing workplace fatigue, they can be incorporated into a single program. HOS limits can establish the "outer bounds" of duty times while scientific scheduling models form the basis of specific schedules within the bounds.

"In addition to HOS limits, an FRMS for maintenance will include a range of interventions addressing the task, the work environment and the fitness for duty of personnel," the report said. "Whatever approach to fatigue risk management is applied, commitment from all levels of the organization is essential. Upper management has a responsibility to state a clear policy on fatigue, including how fatigue-related incidents will be dealt with under a just culture."

Notes

1. Hobbs, Alan; Avers, Katrina Bedell; Hiles, John J. *Fatigue Risk Management in Aviation Maintenance: Current Best Practices and Potential Future Countermeasures*. DOT/FAA/AM-11/10. June 2011.
2. Folkard, Simon. U.K. CAA Paper 2002/06, *Work Hours of Aircraft Maintenance Personnel*. West Sussex, U.K.: Research Management Department, Safety Regulation Group. 2003.

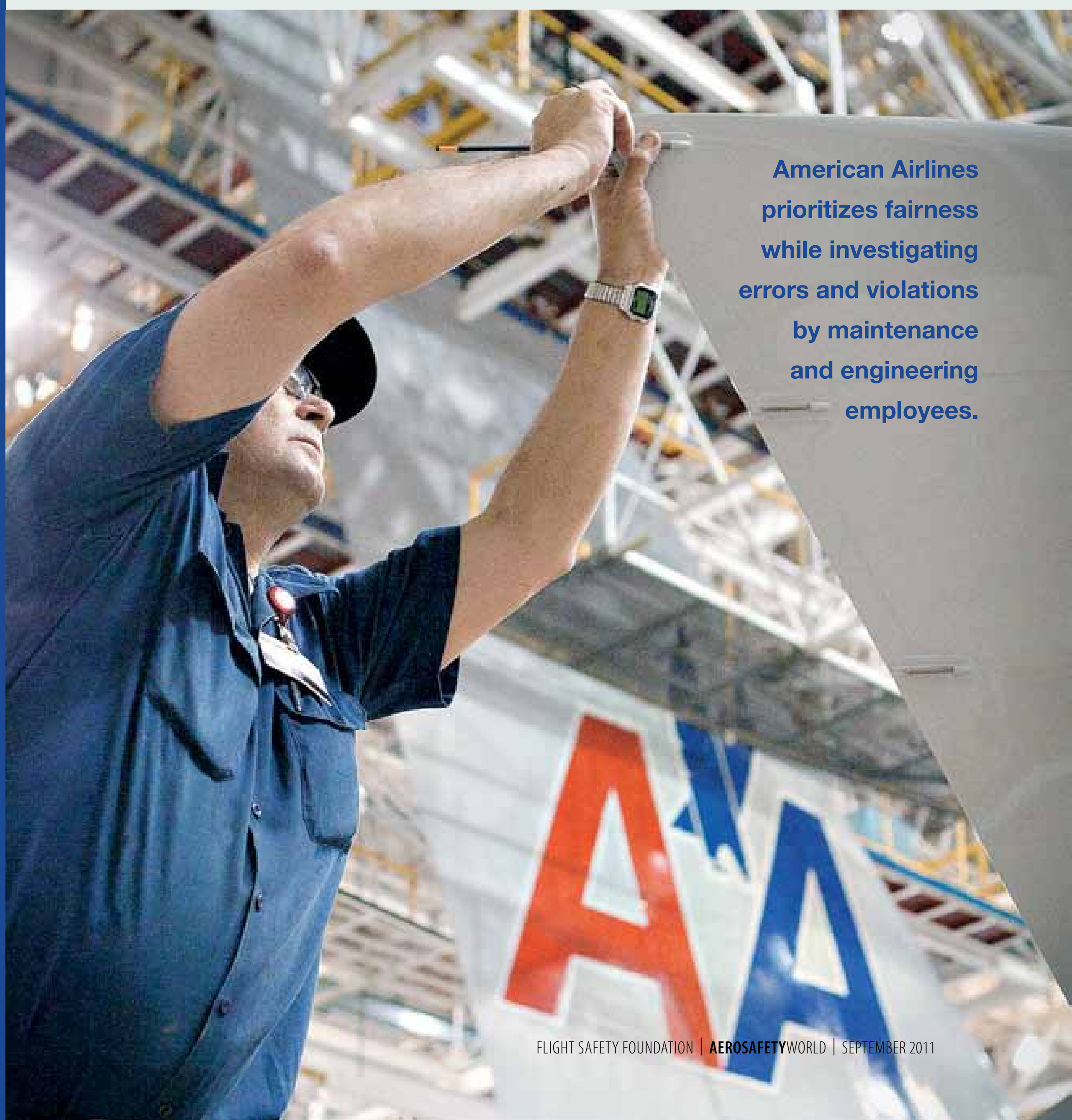
JUST POLICY

BY BRAD BRUGGER AND PETE SIRUCEK

American Airlines prioritizes fairness while investigating errors and violations by maintenance and engineering employees.

On June 15, the American Airlines Maintenance and Engineering Organization (known as M&E) implemented a new policy designed to enhance the company's ability to learn from errors and violations in the workplace, and to identify the most effective actions we can take to prevent their reoccurrence. Basically, our approach applies just culture philosophy and tools, and standardizes previously diverse investigative processes into one cooperative investigation that considers errors and violations as learning opportunities for everyone, not just our aviation maintenance technicians. The resulting document is titled *Just Policy for Maintenance Errors and Violations.*

The greatest benefit that we expected already is becoming a reality: preventing rash decisions by managers after a costly outcome that, in the past, would have focused their attention on "disciplining the last person who touched the airplane." We also are now setting up, as quickly as possible, a method of communicating internally the high-impact lessons we are learning. We expect this innovation to strongly complement, and even enhance, the tools in our aviation safety action partnership (ASAP) program for M&E personnel.



The authors say that implementing their *Just Policy*; communicating the benefits of its principles and tools; and, in the future, sharing lessons learned are opportunities to give back to other airlines that have been generous with best practices.

Photos: © Byron Totty, American Airlines photography

The *Just Policy* first lays out our organization's commitment to four core principles: the recognition that not every system is perfect, to err is human, to drift from what we know to be safe or compliant is human, and that risk is everywhere; we are most interested in learning as much as possible after an error or event to understand risk at the individual level and the organizational level; we are willing to investigate, to learn from our mistakes and to share what we have learned; and we are determined to balance accountability with justice.

This philosophy encourages our employees to be open, forthright and honest and, psychologically, to "get to a place of comfort" where they are willing to talk about what happened or what they did; to help identify the root causes and all the contributing factors; and to learn from the factors. The policy also establishes clear personal accountability for at-risk behavior and reckless behavior (see "*Just Policy* Definitions," p. 30).

The *Just Policy* requires a strong sense of "shared accountability" at all levels of M&E. This means that M&E management is responsible for designing a reliable system — processes, procedures, resources, facilities and incentives necessary to produce the desired outcomes (for example, quality, safety and regulatory compliance) — and for managing employees in a fair and just manner. In turn, each employee is responsible for making good choices and for reporting safety concerns, near-misses or errors/violations when they are identified.

Writing the policy led us to reconsider M&E values, rejecting the past punitive approach in which judgments could take place too quickly, and instead fostering a fair and consistent process that stresses learning. Our goal is to truly understand why something happened and to share the accountability. For example, we no longer want any M&E manager to become hung up on the bad outcome — the U.S. Federal Aviation Administration (FAA) finding, the damage or whatever it was.

Neither management nor the union can sit back if that occurs, only to realize later that known errors or violations, or a bigger systemic problem, were not being reported or were being tacitly approved. It's especially unfair in such cases to treat one unlucky mechanic — the one who got caught — as a scapegoat when we should have identified the bigger problem.

If the system is the issue, the first task is to fix the relevant process. If the mechanic made a poor choice but the process is fine, the mechanic likely just drifted away from what he or she was taught. But, in reality, what we most often find is that an error, violation or event involved a little bit of both aspects.

As in the past two years of the M&E ASAP program, at-risk behaviors remain the most common issue while reckless behaviors are rare. So addressing at-risk behaviors provides us the best opportunity for making good systemic changes and focusing on coaching, mentoring and role modeling.

Technically, the policy only guides M&E management. It does not require anything new of non-management personnel: They are still responsible for reporting hazards and safety concerns when they see them. The major difference has been the safe avenue for the reports of an error, violation or event — especially one not submitted voluntarily to the ASAP program by the employee — to be received, accepted and acted upon by management in our just culture environment.

Writing the *Just Policy* also opened an opportunity to standardize and consolidate several investigative processes. Disjointed processes and poor results previously had inhibited M&E efforts to learn from them, incorporate sound fixes to the system, and respond consistently.

Now, the initial (preliminary) investigations are conducted by representatives of M&E management; the initial investigations are then forwarded to our maintenance event assessment aid (MEAA) investigation group. The MEAA investigation group then coordinates the investigation with the ASAP event review committee if an associated ASAP report has been filed. Standardized processes that have been designed to improve their cooperation ensure that the representatives are all working towards, and achieving, desired quality results that enhance a robust safety culture and align M&E with the American Airlines safety management system (SMS).

Just Policy Definitions

At-risk behavior: A behavioral choice that increases risk where this risk either is not recognized, or is mistakenly believed to be justified.

Human error/error: An inadvertent action; unintentionally doing something other than what should have been done; a slip, lapse or mistake.

Just culture: The American Airlines Maintenance and Engineering Organization's (M&E's) philosophical mindset and management method, focused at all levels on learning, fairness and consistency, safe system design, and making/managing quality choices.

Just Culture Algorithm: A trademarked algorithm developed by Outcome Engineering, applied during the consistent process of investigating an error or violation, to assess the quality of behavioral choices and duty breaches.

***Just Policy for Maintenance Errors and Violations*:** The document that states the M&E's commitment to enhance safety culture and specifies company management actions to respond to errors, violations and events (i.e., accidents, incidents or other reportable actions/occurrences).

Maintenance event assessment aid (MEAA): The M&E process used as a nonpunitive, system-focused investigative tool that identifies the root causes and contributing factors of an error, violation or event.

Reckless behavior: An employee's behavioral choice to consciously disregard a substantial and unjustifiable risk.

Safety management system: The M&E-wide approach to managing safety risk and assuring the effectiveness of safety risk controls.

Violation: An infraction or breach of a work-related regulation, company policy/procedure/rule, professional standard or training.

— BB and PS

Safety Champions

The role of Outcome Engineering, our consultant in this evolving field of aviation safety, has been to transform theoretical principles of just culture into practical guidance and tools that also draw principles from safety engineering, human factors and law. Their trademarked tool, called the Just Culture Algorithm, enables neutral M&E employees trained and certified in its use (called *safety champions*) to easily identify system deficiencies and to objectively assess the quality of choices made by individuals.

The algorithm, associated definitions and training previously had been used and tested for effectiveness within our four ASAP programs as part of an 18-month coordinated study for the FAA Aviation Flight Standards Division for Voluntary Reporting (AFS-230).

The study provided a unique opportunity to address the U.S. airline industry's concern about undefined or inadequately defined report-rejection criteria in ASAP programs. When the study concluded, leaders of all our airline's ASAP programs agreed to indefinitely continue using this tool, which clearly defines "where the line is drawn" and limits the range of allowable actions to be taken by M&E and the FAA.

With respect to errors, our intent is to support the erring employee by conducting a "learning conversation" about why the error occurred and what can be done to prevent a reoccurrence. Resulting nonpunitive actions also focus on correcting system deficiencies to meet this objective.

With respect to at-risk behaviors, our intent is to coach the employee about the behavior during a supportive discussion that reinforces safe behavioral choices. The MEAA process identifies for managers the typical reasons why employees engage in at-risk behavior, and frames nonpunitive solutions that balance positive and negative incentives that influence employees. Often, at-risk behaviors evolve into "norms." In these cases, the investigation expands to identify and coach employees and management regarding at-risk behaviors at the system level (maintenance crew, maintenance station, region, etc.).

ASAP Tool Refinement

In the context of the FAA's forthcoming regulation on SMS in aviation maintenance, M&E had envisioned the *Just Policy* as an opportunity to expand just culture beyond our ASAP. We hoped this would ensure a strong foundation before implementing the SMS.

Safety engineering and human factors aspects of just culture had been incorporated into American Airlines operating departments since the 1990s. Prior to writing the *Just Policy*, just culture had been applied in the "vacuum" of the M&E ASAP process. So the "legal" aspects of just culture — shared accountability and defined behaviors — are new. The successful, formal incorporation of just culture into ASAP in 2009 therefore brought a deeper awareness of the benefits of applying these principles to the management of risk.

In practice, except for refining tools, the *Just Policy* has not changed significantly our ASAP program. The prime example of refinement the policy has brought about has been application of the Outcome Engineering definition of reckless behavior to better understand the ASAP term "intentional disregard for safety" as the rejection criterion — that is, the reason that an event review committee would decline to accept an employee's voluntarily submitted report of an error or violation for nonpunitive consideration under the ASAP process.

Moreover, adapting the Just Culture Algorithm to the M&E ASAP has ensured standard and consistent criteria for determining the specific behaviors involved in any event, error or violation. This became a means to more accurately assess, and effectively respond to, behavioral choices that may increase risk, and to more clearly identify system design flaws.

The *Just Policy* states that, for identified reckless behaviors, some level of corrective action by the company — that is, measures beyond nondisciplinary remedial action per guidelines of American Airlines' Peak Performance Through Commitment policy — is appropriate to cause an individual to refrain from undesirable behavioral choices.

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Plans call for developing an investigation training package, designed to enhance the quality of that process, including root-cause analysis.

Decision Algorithm

The purpose of the algorithm in our ASAP and non-ASAP processes is to objectively allocate responsibility — to identify what role the organization played in system design and to assess the quality of choices made by individuals working within that system. Then the process clearly defines when it is appropriate to support the employee, to coach the employee or, in the rare cases typically indicated, to take disciplinary action against the employee.

The *Just Policy* specifies use of the MEAA, our version of Boeing Commercial Airplanes' Maintenance Error Decision Aid (MEDA) and the Just Culture Algorithm as the tools for investigating human factors and root causes. The policy also places the ownership (i.e., responsibility for the MEAA and just culture processes and tools) on a small group of neutral, trained and qualified personnel.

If this group concludes that an error or violation involved reckless behavior, the policy requires a joint ratification of the conclusion by

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the company's director of maintenance and the safety of flight and compliance coordinator of the Transport Workers Union of America. The director of maintenance also has been designated as the responsible person for directing training and communications activities for all aspects of M&E.

Training covers preliminary steps that local managers or supervisors must take when they become aware of a maintenance-related error or violation. The steps were designed to ensure that all subsequent fact-gathering is conducive to learning as much as possible about the error or violation and preventing re-occurrence, to improving system design and to managing employees fairly.

The insidious aspect of at-risk behavior is that past success in deviating from a rule with no bad outcomes — or, more typically, with apparently positive incentives or reinforcements — leads to false confidence about the safety of the behavior.

A typical time that at-risk behavior occurs in M&E is when a group of employees become confident in taking a shortcut or otherwise develop their own unapproved "standard practice." Often, these behavioral choices are made by well-intentioned employees just trying to get the job done with limited time or resources. The coaching leads to improving the system by removing the incentives that drive the at-risk behavior.

M&E also recognizes from experience that it is rare for an employee to act recklessly. We therefore believe that disciplinary action is only appropriate in the case of a reckless choice, to discourage the reckless choice. M&E, through our *Just Policy* and sharing lessons learned, identifies and clearly communicates the difference between an at-risk behavior and a reckless act.

Front Line Challenges

"Road show" presentations about the policy to M&E personnel, which began before it was finalized, and our later training discussions have been invaluable. Discussions and questions from the management and union personnel who attended the road shows allowed us to fine-tune the *Just Policy* before it was officially implemented.

Despite joint management-union leadership in writing the policy and early communication, the biggest challenge we face appears to be earning the trust of all employees. For the most part, management and union personnel say they agree with the policy, but some union personnel are skeptical that the company will remain committed to it and apply it consistently.

In fact, one initial response from M&E management personnel has been that, even without the policy, a "good manager" already should have been treating employees according to its basic principles. At the organization level, however, management had struggled to fairly and consistently apply — regardless of the severity of the outcome involved (costs of injuries, damage, delays, production time, rework, etc.) — just culture principles to all cases of errors and violations.

We are optimistic that gaining acceptance of the policy will not be as difficult once everyone affected understands the personal implications and sees the policy in practice. Union personnel have said they appreciate the policy's commitment that they will be treated fairly if they ever face these circumstances. So far, the implementation of the *Just Policy* has met M&E values and expectations.

As of September, the *Just Policy* implementation team is pushing into the field detailed training on roles and responsibilities of management and labor union leaders across the system. Upcoming reinforcement training for all other M&E employees will focus on basic principles, risk recognition and especially the individual employee's role and responsibility for reporting hazards within the M&E SMS.

Brad Brugger <bbrugger@twu.org> is safety of flight and compliance coordinator for the Transport Workers Union of America at American Airlines. Pete Sirucek <pete.sirucek@aa.com>, director of maintenance at American Airlines and managing director FAA liaison, is the designated responsible person for the Just Policy adopted by the company's Maintenance and Engineering Organization.


Whatever it Takes
Pilot Larry Erd, Falcon 7X Captain, lands at London Luton, with an inboard slat fault alert. He quickly checks the aircraft system and then confirms he is AOG – and his next flight is on the following day.
He calls Dassault's Technical Center in Paris and gets Insy Houang – Customer Service Engineer and an on duty 7X specialist. Together they access the aircraft on-board Central Maintenance Computer to identify the fault code.
Insy coordinates assistance and parts shipment via Eurostar, from Paris-Le Bourget to Luton. Go Team technicians from Dassault's Luton Satellite install a new flight control PCB the next morning and Larry e-mails back later to Dassault Falcon:
"The airplane performs really well and Customer Service is doing an incredible job too."
GoTeam
Whatever it takes
Falcon GoTeams do whatever-it-takes to turn your AOG into an Airplane On The Go.
Learn more at falconjet.com/Go
DASSAULT FALCON
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Another Look at SMOLENSK

BY MARK LACAGNINA

Polish report says that a radar malfunction was involved in the Tu-154 crash.

Erroneous on-track, on-glide-path callouts by an air traffic controller during a radar-assisted nonprecision approach likely encouraged the flight crew to continue the approach despite the presence of thick fog, according to an independent report by Polish authorities on the April 10, 2010, crash of a Tupolev 154M at Smolensk, Russia.

The report by the Polish Committee for Investigation of National Aviation Accidents said that the Tu-154 was not within flight-path deviation limits and concluded that the controller's guidance errors were caused by a malfunction or mistuning of the radar system at Smolensk Severny Airdrome.

The aircraft struck terrain short of the runway, killing all 96 people aboard.

Similar to the report published last year by the Interstate Aviation Committee (IAC), the Polish committee's report primarily faults the flight crew for the accident, saying, "The immediate cause of the accident was the descent below the minimum descent altitude at an excessive rate of descent in weather conditions which prevented visual contact with the ground, as well as a delayed execution of the go-around procedure."

The IAC report said that the immediate cause of the accident was the flight crew's failure to proceed to an alternate airport after being told repeatedly that the weather conditions at Smolensk were significantly lower than the nonprecision approach minimums (*ASW*, 2/11, p. 20).

The findings of the investigation committees appear to differ mainly in the extent to which air traffic control (ATC) and the presence on the flight deck of the commander-in-chief (CIC) of the Polish air force contributed to the accident. Compared to the IAC report, the 328-page Polish report gives greater weight to the former and less to the latter. It provides the following details about the accident flight:

The Tu-154 and a Yakovlev 40 operated by the 36th Special Airlift Regiment of the Polish air force were assigned to transport VIPs to Smolensk for a commemoration of the 70th anniversary of the Katyn Massacre during World War II.

Weather conditions at Smolensk deteriorated rapidly after the aircraft departed from Warsaw. The crew of the Yak-40, which was about 20 minutes ahead, was able to land at Smolensk but later told the Tu-154 crew that visibility had decreased to 400 m (1/4 mi).

As the Tu-154 neared Smolensk, the aerodrome controller told the crew that the airport had "unsuitable landing conditions." The commander replied, "If possible, we shall attempt approach, and if the weather is too bad, we will go around."

The commander told an aide to Polish President Lech Kaczinsky, who was among the passengers, that they would not be able to land and asked for a "decision as to what we are going to do." The aide later returned to the flight deck and said that a decision had not been made.

The only instrument approach available was based on two nondirectional beacons supplemented with radiolocators used by a landing zone controller to inform pilots about their position relative to the threshold of Runway 26, the 2.7-degree glide path and the extended runway centerline. The published minimum descent altitude was 100 m (328 ft).

The air force CIC came to the flight deck as the crew was being vectored to the final approach course. Although he did not don a headset and spoke only twice, making an altitude callout at 100 m and a comment about "nil visibility" later in the approach, the report said that his (and the aide's) presence on the flight deck was "unacceptable" and "could have distracted the crew and drawn their attention away from core duties."

The landing zone controller advised the crew several times of their distance from the runway threshold, saying each time that they were "on track and path" although the aircraft was above the acceptable glide path deviation limit and left of the extended centerline limit. The controller made the same callout when the Tu-154 later descended 20 m (66 ft) below the glide path and was 80 m (262 ft) left of the extended centerline.

The report concluded that the "absence of reaction" by ATC to the Tu-154's flight path deviations was the consequence of a malfunction of the radar system's gain adjustment, interference with the radar signals by trees that had grown beyond the permissible height along the final approach path or errors in the manual tuning of the system.

Early in the approach, the copilot reacted to a terrain awareness and warning system (TAWS) "TERRAIN AHEAD" warning by adjusting the altimeter setting to increase the indicated altitude and "fool the TAWS," the report said. The crew did not respond to "PULL UP" warnings generated later in the approach.

The Tu-154 was at a radar altitude of 91 m (299 ft) and 698 m (2,290 ft) from the runway threshold when the commander announced that he was initiating a go-around. He pulled the control column back and increased thrust, but the aircraft continued losing height due to inertia. A section of the left wing struck a tree and separated. The aircraft rolled inverted and struck rising terrain.

Among the "contributing circumstances" cited by the report were the crew's failure to monitor altitude and respond to the TAWS "PULL UP" warnings, and the controller's on-track, on-path callouts, "which might have affirmed the crew's belief that the approach was proceeding correctly."

The report also is highly critical of the 36th Special Airlift Regiment, describing the flight crew's training and preparation for the flight as "hasty [and] haphazard." According to media reports, the regiment was disbanded in August, and government flights were reassigned to Poland's commercial carrier, LOT Airlines.

This article is based on the English translation of the Polish committee's final report, 192/2010/11, available from the Polish Ministry of Internal Affairs and Administration at <mswia.datacenter-poland.pl/FinalReportTu-154M.pdf>.

Computer simulations validate risks involved if airline pilots consider a go-around after touchdown.

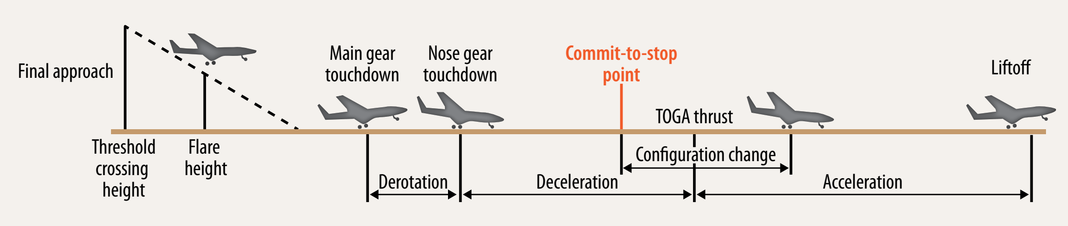
Point of No Return

BY WAYNE ROSENKRANS | FROM ORLANDO

Knowledge of the deceleration/acceleration forces and human factors involved in rejecting a landing after touchdown — especially on a contaminated runway with significant crosswind — should inform flight crews' risk assessments before arrival in a regional jet or other turbine-powered airplane, says a U.S. academic researcher. If communicated via graphs and diagrams in training, aircraft flight manuals and approach briefings, and via aural and graphical alerts from avionics (*ASW*, 11/09, p. 26, and 8/10, p. 30), imperceptible risks become readily apparent, according to Nihad Daidzic, a professor in the Department of Aviation at Minnesota State University, Mankato.[1]

His perspective of when an overrun becomes preferable to a go-around[2] comes from study of the July 2008 Hawker 800A accident at the neighboring Minnesota airport in Owatonna (*ASW,* 4/11, p. 16) and hypothetical commit-to-stop scenarios involving typical business jet speeds and accelerations. These scenarios were analyzed that year

Simulating a Go-Around After Touchdown



TOGA = takeoff/go-around

Notes: Mathematical submodels for each landing phase shown were designed to enable the landing model and a flight simulation program to calculate operational landing distances, including a basis for designating a commit-to-stop point, and to realistically analyze variations in pilot techniques. For educational purposes, the submodels account for effects of a stabilized or unstabilized final approach; variation from main gear threshold crossing height of 35-50 ft; variation from a proper height at flare and touchdown point; variation from 3-second derotation; maximum safe elapsed decision time before decelerating to minimum TOGA action speed; an assumed 1,000 ft (305 m) for configuration change with or without thrust reversers; and no assumed provision for engine failure or departure obstacles while accelerating to safe liftoff speed by the end of the runway.

Source: Adapted from Nihad Daidzic

Figure 1

with a computer simulation that he developed for studies of runway overruns on contaminated runways (for which the Boeing 737-800 was modeled as an example applicable to large commercial jets),[3] and of runway veer-offs (for which a Bombardier CRJ700 was modeled as an example applicable to regional jets). He discussed results at the World Aviation Training Conference and Tradeshow (WATS 2011), April 19–21, in Orlando, Florida.

Overruns and veer-offs have occurred with "stubborn frequency" despite industry initiatives throughout at least 20 years, such as the 2000 and 2010 versions of the Flight Safety Foundation *Approach-and-Landing Accident Reduction Tool Kit*, Daidzic said.

"Go-around safety is actually a problem for every airplane, although at WATS 2011 I am talking specifically about regional airline operations," he said. "In 2008, I called this a *point of no return* [also called a commit-to-stop point] on the runway, referring then to the lowest speed that the airplane can slow down to before the crew initiates the go-around. My objective has been to understand some of the dynamics in pilot response when the airplane has already touched down and the crew is trying to execute a go-around [Figure 1]."

As recently as 2010, a non-U.S. fatal accident with this element reminded government and industry safety specialists of the continued importance of related academic research, policies and pilot education (see "Committed to Stop," p. 39).[4]

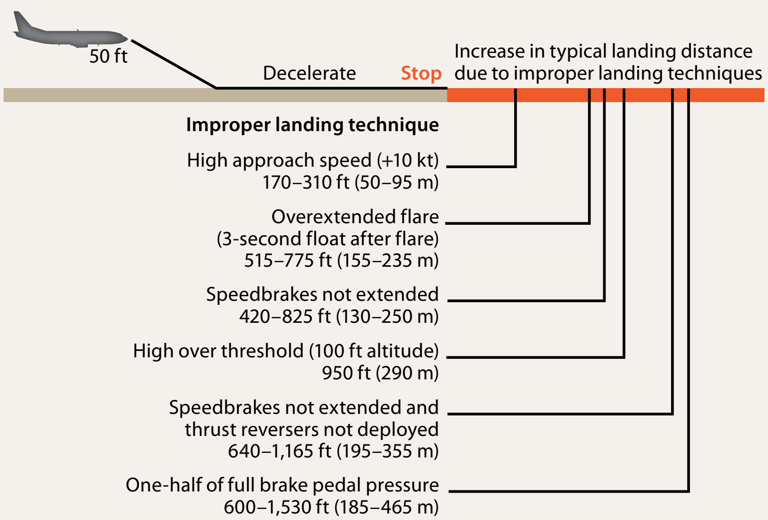
"Operators need to have standard operating procedures [SOPs] and a clear policy on if, how and when to execute a go-around after touchdown," he said. "For regionals or majors, this scenario can be much more hazardous than a V_1 cut (action speed)," that is, practicing complete loss of power from one engine at the maximum airspeed in the takeoff at which the pilot must take the first action (for example, apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance (*ASW,* 7-8/11, p. 23).

"After the point of no return, it is far better to accept the possible overrun than to attempt a go-around," Daidzic said. "This point on the runway, defined in the model by airspeed," with its associated minimum takeoff/go-around action speed and maximum safe elapsed time, "is the dynamic location of the last-chance go-around attempt after actual touchdown and landing roll. The exact point in flight operations could depend on any of many factors — airspeed, wind, distance, touchdown location, deployment of thrust reversers, runway contamination condition, engine failure in attempted go-around, and so forth." Certainty about the exact point — absent a head-up display/head-up guidance system or other equivalent capability in a primary flight display/multifunction display — may not be possible, he indicated, but early recognition of risk factors can be trained (Figure 2, p. 38).

Factors modeled in the various simulations have included the pilot indecision time, airplane height and speed above the runway threshold (kinetic energy state/inertia), flare technique, touchdown point (air distance from threshold), friction generated by brake systems, runway surface condition, speed-dependent rolling friction coefficient, stages of ground spoiler deployment/lift dump, thrust-reverser deployment, duration of configuration changes, drag, density altitude and the gravitational effects of an uphill or downhill runway. Slopes of lines on resulting graphs — representing deceleration rates and elapsed time — emphasize the critical importance of a stabilized approach to a safe landing.

"Many experts who studied veer-offs in the past recommended that

Typical Factors Affecting Landing Distance



Notes: These data from the *Boeing 737 NG Flight Crew Training Manual* were published by the India Ministry of Civil Aviation Court of Inquiry following its investigation of the May 2010 landing accident in which the flight crew attempted a go-around at Mangalore. Distances shown vary with wet or dry runway condition; the data exclude contaminated runway considerations.

Source: Boeing Commercial Airplanes

Figure 2

pilots get out of reverse thrust and put back in forward thrust," Daidzic said. "Sometimes pilots do not have time to do that. Then they would be between a 'hammer and a hard place' because, if they get out of reverse thrust on a slippery runway, they are going to overrun. So they have to choose between one of these two — it's going to be an overrun or a veer-off. But with better, accurate models in flight simulation training devices, pilots easily could practice corrective actions in many landing scenarios — slippery runways with crosswind, and so forth." Effects of unstabilized approaches and the "excessive penalty" imposed by failure to use thrust reversers in slippery or hydroplaning conditions also could be demonstrated.

His own veer-off simulations represented forces acting on a Bombardier CRJ700 with General Electric CF34-8C5 engines landing on a slippery runway in a crosswind, he said. The crosswind force tends to make the airplane slide sideways, and the effect of this lateral force also changes depending on the use of deceleration devices, complicating pilot assessments of go-around feasibility.

These simulations used the CRJ700 performance data set and a 5,500-ft (1,676-m) runway while varying other factors, such as nose-gear touchdown at 1,500, 2,500 and 3,500 ft [457, 762 and 1,067 m] from the threshold; liftoff speed of 120, 130 and 140 kt; and headwind or tailwind. The model calculated minimum safe go-around speed and the elapsed time to decelerate to that speed, in scenarios with and without thrust reverser deployment, at a given runway length. These are a function of the touchdown/lift-off speeds and touchdown point — an air distance from the threshold plus the distance computed with a 3-second derotation factor.

The graph generated by one CRJ700 veer-off simulation represented a case involving a slippery surface (ice-like friction coefficient of 0.08), a 30-kt direct crosswind and no thrust reverser deployment. With the nose gear on the centerline, the downwind main gear normally would be positioned 40 to 65 ft (12 to 20 m) from the runway edge. After about 10 seconds without corrective action, however, the CRJ700 wound up about 13 ft (4 m) from the runway centerline, he said.

"Either the left or right main gear then would be about 30 to 50 ft [9 to 15 m] from one runway edge or the other, but this is not the worst-case scenario," Daidzic said. "If we look at a case with thrust reversers, the airplane turns into the wind due to directional stability. Unless the pilot uses some aerodynamic controls — such as turning into the skid, which puts the airplane nose downwind with the thrust reversers then counteracting the wind — after landing on the runway centerline, after 10 seconds, the airplane would be about 50 ft off or more and thus already in a ditch."

If these scenarios had been compounded by inadequate crosswind control during the approach — creating airborne lateral drift of 3 fps (1 mps), for example — the airplane already would have been displaced from the centerline by about 10 ft (3 m) by the time of nose gear touchdown. "In a matter of 10 seconds, this pilot already would have experienced a veer-off, and the speed would be very high," Daidzic said. "Because of the slippery runway, the airplane would not be slowing as quickly, so the speed generally would be about 100 kt, and that can be fatal."

Go-Around Window

An example from one table in his commit-to-stop simulation results for a typical business jet, but applicable to any airplane given suitable runway length, showed how brief the opportunity can be to initiate the go-around. The assumptions were a 1,000-ft (305-m) indecision and configuration change distance, hydroplaning surface and maximum thrust after thrust reverser deployment. "Say

Committed to Stop

Results of a U.S. National Transportation Safety Board (NTSB) performance study during the investigation of the Hawker 800A accident in July 2008 have rekindled concerns about procedures and training regarding go-arounds after touchdown in turbine-powered airplanes (*ASW*, 4/11, p. 16). "Establishing a committed-to-stop point in the landing sequence beyond which a go-around should not be attempted for turbine-powered aircraft would eliminate ambiguity for pilots making decisions during time-critical events," said the NTSB's final report. "If the [accident] captain had continued the landing and accepted the possibility of overrunning the runway instead of attempting to execute a go-around late in the landing roll, the accident most likely would have been prevented or the severity reduced because the airplane would have come to rest within the runway safety area."

The most closely related safety recommendation to the U.S. Federal Aviation Administration (FAA) in the NTSB's March 2011 report said, "Require manufacturers of newly certificated and in-service turbine-powered aircraft to incorporate in their aircraft flight manuals a committed-to-stop point in the landing sequence (for example, in the case of the Hawker Beechcraft 125-800A airplane, once lift dump is deployed) beyond which a go-around should not be attempted." A companion recommendation said that, upon completion of this manual revision, specific categories of operators and flight training schools should be required to incorporate that information into their manuals and training.

Regarding on-board tools, possibly including decision support for go-arounds, the NTSB also recommended that the FAA, "Actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it becomes available, require that the technology be installed."

The report also discussed the operator's inadequate policy, procedures and training, noting, "None of the guidance explicitly states that a go-around should only be conducted before landing or identifies a committed-to-stop point (that is, a point in the landing sequence beyond which a go-around should not be attempted). … The NTSB notes that other recent overrun accidents have not been as catastrophic because the flight crews did not attempt to go around after landing. … [Two other recent U.S. accidents][1] might have been prevented if the pilots had committed to the landings or better understood where the committed-to-stop point was rather than attempting to go around with insufficient runway available to lift off and clear obstacles."

Preventing these situations was an objective of international specialists involved in the 2006–2009 runway safety initiative facilitated by Flight Safety Foundation and the International Air Transport Association. Best practices are on the compact disc titled *FSF Approach-and-Landing Accident Reduction (ALAR) Tool Kit Update,* evidence that the "committed-to-stop" aspect of go-around decisions had received industry attention before the Hawker 800A crash.

Among the *ALAR Tool Kit Update's* warnings originating a decade ago, a video says, "A key factor in making the go-around decision is to constantly reassess your decision to land during the approach. Note that there is a time when it is no longer appropriate to go around — for example, when spoilers and thrust reversers have been deployed. Your operational procedures should have appropriate information regarding these situations, and you should follow those procedures."

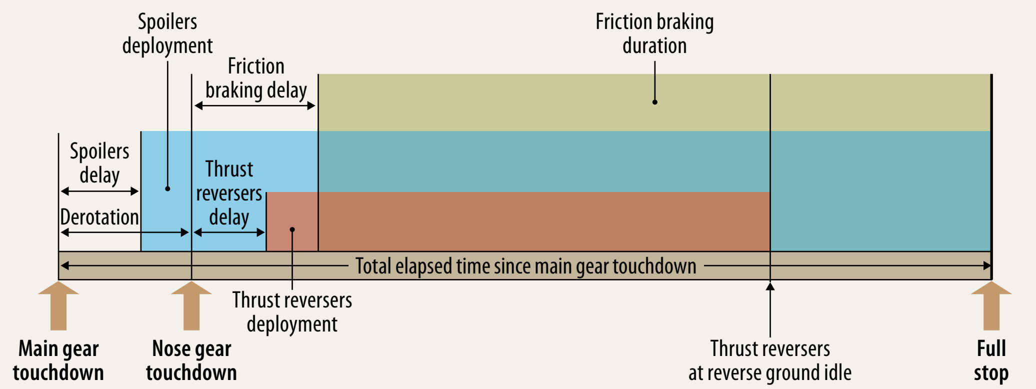
Other examples of expert advice appear in "Reducing the Risk of Runway Excursions: Report of the Runway Safety Initiative," published by Flight Safety Foundation, which says, "Operators should define and train procedures for go-around, including during flare and after touchdown." and the *Runway Excursion Risk Reduction Toolkit,* First Edition 2009, which says, "A go-around should be conducted at any time significant deviations are recognized during the flare and touchdown."

— WR

Note

1. The NTSB could not be certain that these accidents would have been prevented. The board said, "On Oct. 5, 2005, [the pilot of] a Beechcraft 58 overran the runway in Jacksonville, Florida, after attempting a go-around late in the landing roll on a wet, ungrooved runway. … On July 15, 2005, a Cessna 525A collided with a localizer antenna in Newnan, Georgia, after the pilot conducted a go-around late in the landing roll on a wet, ungrooved runway. … As a result of the pilot's delayed decision to go around, the airplane became airborne only 300 ft [91 m] from the runway end."

Every Second Counts After Touchdown on a Contaminated Runway



Notes: A mathematical simulation model was designed to capture time factors, including those imperceptible or difficult to judge for pilots, that cumulatively determine from data the likelihood of stopping on a runway under conditions set by the researcher. Typical landing rollouts for large commercial jets took about 30 seconds on a dry or wet runway and 40 to 50 seconds on an extremely slippery runway, simulations showed. Thrust reversers delay includes time for mechanical interlock actuation and turbine engine spool-up from idle thrust. If required, reverse thrust may continue to full stop.

Source: Adapted from Daidzic, Nihad E.; Shrestha, Juna. "Airplane Landing Performance on Contaminated Runways," *Journal of Aircraft*, November-December 2008.

Figure 3

the groundspeed on touchdown is 120 kt and the nose gear is on the ground by 1,500 ft" beyond the threshold with thrust reversers deployed immediately, he said. "Theoretically, this pilot could slow down to 77 kt in approximately 11 seconds," then select takeoff/go-around thrust and reconfigure the aircraft, "and still lift off in the 4,000 ft (1,219 m) of runway available after touchdown [Figure 3]. For pilots who do not have an accelerometer telling them their deceleration, however, it is very difficult — especially at high speed in a couple of seconds — to gauge how fast they are slowing down."

Moreover, if the pilot touched down long at the same speed — for example, more than 3,000 ft from the threshold or beyond the first third of the available runway — he or she could only decelerate about 12 kt in approximately 3 seconds. In the same "generic" business jet scenario with no thrust reversers, the simulation showed that the minimum ground speed for a safe go-around would be about 107 kt and the maximum safe elapsed time to initiate the go-around would be 14 seconds. Landing long without thrust reversers might reduce that time to 4 or 5 seconds.

The above scenario with maximum reverse thrust reinforces calls for specific SOPs, training and discipline. "If you touch down fast and long in this case, you have less than 3 seconds to make a decision to go around," Daidzic said. "If you pass the point of no return, you have to accept an overrun that can result in an accident because if you try to lift off, the result will be catastrophic."

Essentially, the simulations show that a go-around, theoretically, can be safely attempted after touchdown only if initiated before the known point of no return, he said. Favorable conditions for a safe outcome ideally would include controllable deceleration-acceleration, a runway far longer than landing calculations require, landing on an appropriate touchdown marker, no obstacles in the departure flight path, a go-around decision before (or not more than three seconds after) main-gear touchdown and at least the calculated minimum go-around speed. "On a contaminated runway — or especially when hydroplaning — the pilots maybe would not know that the airplane has no chance of stopping and would be overrunning at 30, 40 or 50 kt," he said. Visually judging the deceleration rate in darkness also would increase the difficulty in this case.

Notes

1. Daidzic also is an adjunct professor of mechanical engineering, with a doctorate in fluid mechanics, and holds an airline transport pilot certificate and a certified flight instructor–instrument rating, among other pilot qualifications.

2. Daidzic, Nihad; Peterson, Thomas. "When go-around is impossible — defining the point of no return." *Professional Pilot,* December 2008, p. 110.

3. Daidzic, Nihad E.; Shrestha, Juna. "Airplane Landing Performance on Contaminated Runways in Adverse Conditions." *Journal of Aircraft,* Volume 45 (November–December 2008), p. 2131.

4. The captain of a Boeing 737-800 attempted to conduct a go-around at Mangalore, India, in May 2010, after touching down about 5,200 ft (1,585 m) from the landing runway threshold and deploying thrust reversers, resulting in a fatal accident (*ASW,* 5/11, p. 12).

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Dusty AND

BY ED BROTAK

It was a typical early summer evening in southern Arizona, U.S., this past July 5. At 1751 local time, the Phoenix Sky Harbor International Airport was reporting 10 mi (16 km) visibility with winds of 7 kt. But all that changed in a matter of minutes.

A 1 mi (1.6 km)-high, 100-mi (1610 km)-wide wall of dust roared in from the southeast, moving at 30–40 mph (48–64 kph). At the airport, the leading edge of the dust cloud moved through at 1847. Within minutes, a full-blown dust storm or haboob — Arabic for "strong wind" — was well under way. At its worst, the visibility dropped to 1/8 mi (200 m) and the winds gusted to 46 kt. The airport was closed for 45 minutes. The reduced visibilities and strong winds lasted for hours.

Dust storms pose a significant hazard for aviation. Not only do they drastically reduce visibility, they also are associated with very strong winds that can seriously affect an aircraft in flight. Engines can be damaged by ingesting the dust.

Strong winds associated with a dust storm were believed to be the cause of the May 26, 2011, crash of an air ambulance just outside Delhi, India. Seven people in the airplane and three on the ground were killed when the Pilatus PC-12 turboprop fell from the sky into a residential neighborhood. Officials there said the airplane hit a "wall of air" and was "unable to move due to the strong winds." At the time of the crash, surface winds at the airport were gusting to 40 mph.

Even large airplanes can encounter difficulties. On March 11, 2005, an Airbus A321-200 operated by British Mediterranean Airways encountered a dust storm while

Gusty

Dust storms, including high winds, can occur anywhere there is lots of dry soil.

trying to land at Khartoum Airport, Sudan (*ASW*, 3/08, p. 29). After two aborted approaches, a third approach was attempted. This approach also became unstable when the airplane descended too quickly as it neared the runway. With visibilities below acceptable minimums, the pilot initiated a go-around. The airplane was within 121 ft (37 m) of the ground before the crew pulled up. The event was officially described as a "serious incident." Three years later at the same airport, a Sudan Airways Airbus crashed on landing in a dust storm. Twenty-eight people lost their lives.

Ground operations at air terminals can be brought to a standstill by dust storms. Outside workers can be extremely hampered in, if not prohibited from, doing their jobs. And in the aftermath of the storm, there is the cleanup to deal with. Just as in a snowstorm, the sand/dust must be removed from runways and other critical areas.

To explain the workings of dust storms, we start by clarifying the difference between dust storms and sandstorms. True sandstorms only occur when there is actual sand in the air and therefore are usually confined to the sandy desert regions of the world and their immediate surroundings. Sand grains are larger and heavier than dust and generally cannot be carried as high into the air. Dust storms comprise smaller soil particles which can be carried much higher into the atmosphere, sometimes thousands of feet. Dust storms are much more common than sandstorms. They occur in arid regions, but can also occur in other places and with other soil types, as long as the soil is dry. Drought conditions are often a prerequisite.

Besides loose, dry soil, significant wind is necessary for dust storm formation. Strong winds are needed to mix the dust from the surface into the air and then keep it suspended for a significant time. The wind, of course, will transport the dust particles and make the dust storm move. Fortunately, strong winds without precipitation are fairly unusual outside desert regions. Atmospheric instability can also play a role. The more instability, the more vertical mixing can occur. It is this vertical mixing that can allow the dust to be carried to great heights, as high as 20,000 ft.

As would be expected, dust storms are common in and around the arid and desert regions of the world. The lack of vegetation leaves the soil exposed, with nothing to slow the wind near the surface. However, even the more humid climates are not immune from dust storms. Droughts can dry topsoils and make them more prone to blowing. A weather system associated with strong winds but no precipitation can lead to significant blowing dust.

The strong winds associated with dust storms are produced by a variety of weather systems. In the desert Southwest of the United States, they are usually convective. Strong downdrafts from thunderstorms produce most of the dust storms. At times, the precipitation from the storm evaporates in the dry air before reaching the surface. Only the strong winds make it to the ground. Even when rain reaches the ground under the main convective column, the outflow from the storm's downdrafts has spread out, well ahead of the main storm. The outflow boundary or gust front will be the leading edge of the dust storm. In time, the rain shaft may follow, turning the dust to mud. In the Phoenix dust storm, thunderstorms first developed over 100 mi away, just east of Tucson, in the afternoon. This complex of strong to severe storms moved northwest, with its outflow boundary, the leading edge of the dust storm, reaching Phoenix by evening.

Thunderstorms and the dust storms they produce occur in the summer in the Southwest. It is then that the usually dry region is invaded by moist, tropical air from the south. The "summer monsoons" usually begin in June but occasionally are delayed until July. The Phoenix area usually gets one to three dust storms each summer. Convective dust storms are also common in other parts of the world, such as the Sahara region.

"Convective dust storms" cannot be forecast in advance, and that makes them extremely dangerous. In August 2000, a Bellanca 17-30 single-engine airplane crashed into the mountains outside of Scottsdale, Arizona, killing two. The situation was similar to the Phoenix event — a thunderstorm-generated dust storm.

The best forecast that meteorologists can make is to warn when conditions favor convective development. It is impossible to know exactly where the convective cells will develop and if they will produce a dust storm. Convective dust storms are fairly small — usually tens of miles across. After a dust storm has formed, the U.S. National Weather Service issues either an "advisory" or a full-fledged "warning." A "blowing dust advisory" is issued if the visibility is forecast to temporarily decrease to between 1/4 mi (0.4 km) and 1 mi due to wind-borne sand or dust with winds of 25 mph (40 kph) or greater. A "dust storm warning" is issued if the visibility is expected to drop below 1/4 mi frequently, with winds of 25 mph or greater. The criterion of 25 mph is a minimum; winds frequently range from 40 to 60 mph (65 to 95 kph) in a dust storm.

In the more poleward arid regions and in other drier areas in the mid-latitudes, the strong winds that produce dust storms usually are associated with larger weather systems. To further the discussion, we need to discuss how wind is actually produced. Wind, or horizontal air movement, is the result of pressure differences. Air tries to move from higher to lower pressure. The greater the pressure difference, the stronger the winds. Standard surface weather maps use isobars, lines of equal pressure, to illustrate the pressure field. When the isobars are closer together, there is

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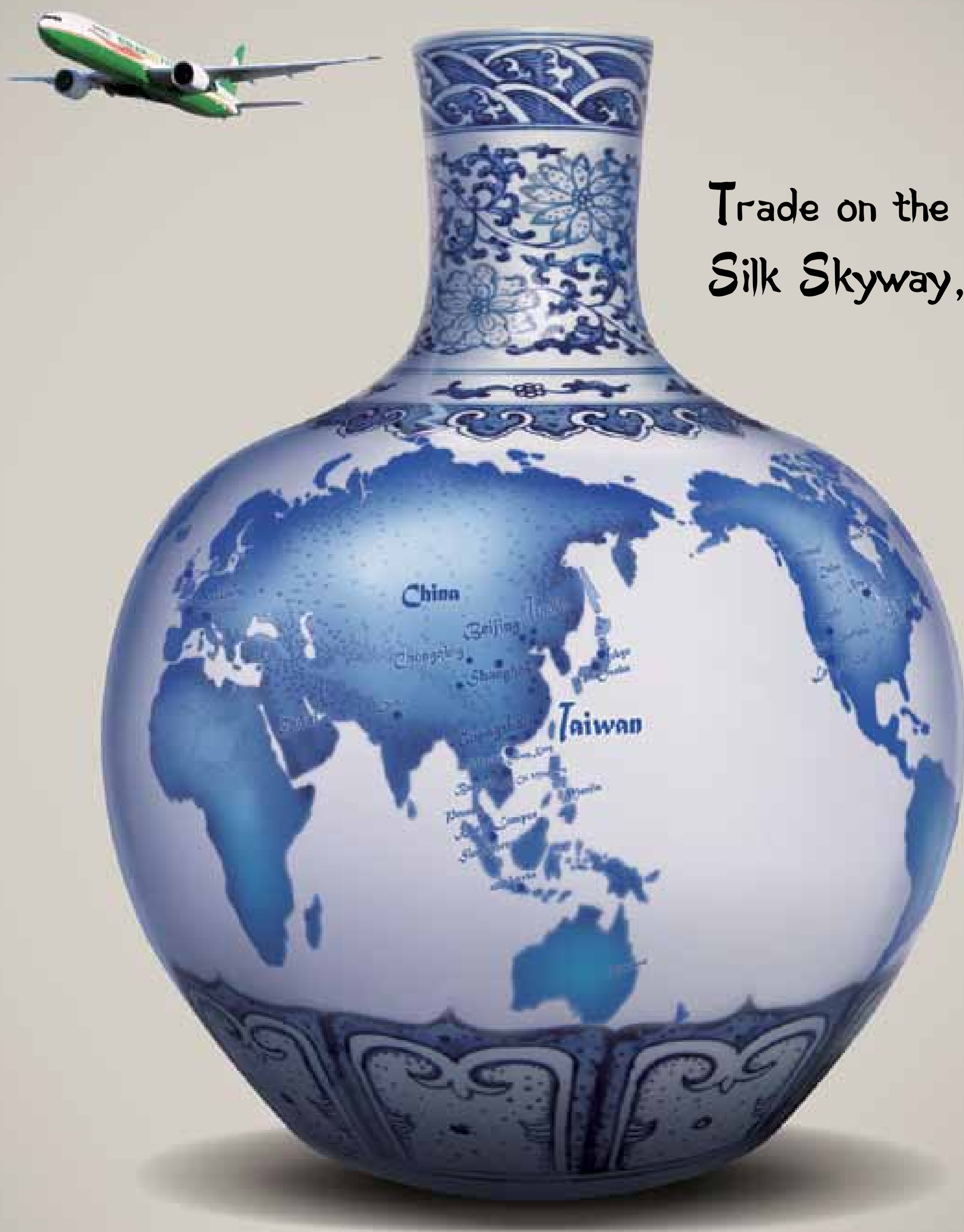

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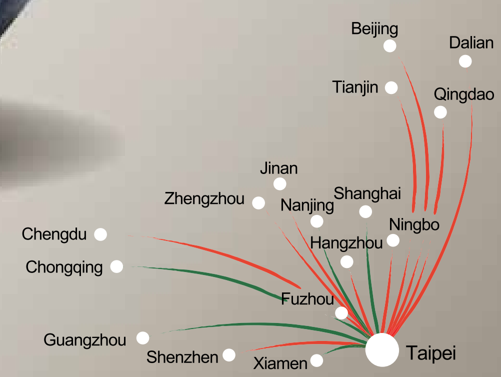

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a stronger pressure gradient and the winds are stronger. The laws of physics confirm what we see in real-world high-pressure areas that have weaker pressure gradients and light winds, whereas lows with tighter pressure gradients have stronger winds. Fronts, associated with lower pressure, can also be accompanied by strong winds.

Low-pressure areas, or cyclones, produce winds that rotate counterclockwise in the northern hemisphere, clockwise below the equator. Stronger cyclones, with lower pressures, produce stronger winds. Winds over 50 mph (80 kph) can be expected with these storms. The winds occur regardless of precipitation. If a source of moisture is available, then as the air is lifted into the low-pressure centers, clouds and precipitation usually form. If moisture is not available, the low only produces wind and the potential for dust storms.

Dust storms associated with these larger, "synoptic-scale" systems are much more widespread than those associated with thunderstorms, often affecting hundreds or even thousands of square miles. On April 4, 2009, a strong low-pressure area to the north generated a dust storm that affected all of central Texas. Lubbock reported wind gusts to 41 kt and reduced visibilities due to blowing dust. At Amarillo, it was even worse, with winds gusting to 55 kt and visibilities as low as 3 mi (5 km) in blowing dust.

In May 2004, dust storms were generated in five different countries on the Arabian peninsula by the same weather system. On Sept. 23, 2009, a dust storm 300 mi (483 km) wide and 600 mi (965 km) long affected two states in Australia. It was the worst dust storm in Sydney in 70 years. Air traffic was halted at Sydney Airport, where the visibility dropped to 1/4 mi with gale-force winds. An intense cyclone and frontal system produced the strong winds.

Besides low-pressure areas themselves, fronts associated with some lows can also cause problems. Dry cold fronts are the worst. Again, the lack of a moisture source prohibits precipitation formation. Dry cold fronts are also often accompanied by steep temperature lapse rates, which increase instability and the vertical depth of any dust storm. On Feb. 24, 2007, a major low-pressure area moved out of the U.S. Rocky Mountains and into the central Great Plains. With a tight pressure gradient, the system was producing strong winds throughout much of the central part of the United States. Of particular concern was a strong, dry cold front extending southward from the low and moving through Texas. At the Dallas/Fort Worth International Airport, strong southerly winds ahead of the front gusted over 20 kt. But the air was moist with dew points near 60 degrees F (16 degrees C). A wind shift to west-southwest near 0900 local time accompanied the frontal passage.

Although a few rain showers had preceded the front, the air quickly dried behind it. Dew points dropped precipitously, reaching as low as 9 degrees F (minus 13 degrees C). Winds increased and at times gusted to nearly 50 kt. By 1500, dust and sand moved in from the west. Horizontal visibility plummeted, dropping at times below 1 mi with the vertical visibility below 1,000 ft (305 m). The combination of low visibility and strong winds persisted for hours. Much of Texas dealt with similar conditions.

Even with these larger weather systems, dust storms are difficult to predict. It takes just the right combination of wind and dry soil. And dust storms are becoming more common around the world. In the United States, the Colorado Plateau region saw a record 14 large dust storms in 2009. Northern China now averages 30 dust storms a year. Iran is reporting an ever-increasing number of events. In some regions, dust storms can be linked to poor agricultural practices. In other areas, drier conditions and more drought occurrences are significant factors. Some believe that global climate change is tied into this. Regardless of the causes, dust storms will continue to be a major aviation hazard in many parts of the world.

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.

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THE NEED TO Notice

BY THOMAS ANTHONY WITH CHRIS NUTTER

Hazards can evade identification when not clearly perceived.

There has been a great deal of discussion lately about organizational responsibility versus individual responsibility for aviation mishaps. Although the main body of research for the last 30 years has shown that aviation accidents mainly are organizational accidents, the role of the individual — the pilot, maintenance technician, dispatcher, etc. — cannot be discounted. The answer to the organization/individual dilemma might lie in the role of perception in hazard identification.

A previous article (*ASW*, 3/11, p. 30)[1] discussed the unspoken language of threat and error management (TEM), which comprises three words: *Huh?*, *Whoa!* and *Phew!* The central theme was that each of us builds up a valuable library of lessons based on our training and experience. Some lessons are easily recalled as they are stored in our conscious minds. Other lessons have been partially forgotten and exist primarily in our subconscious minds.

In this context, *Huh?* (*I wonder what that is?*) is the most important word in TEM's unspoken language because it represents the recognition that something is not right. The question comes unbidden from the lessons stored in our subconscious. When the question arises while performing an operational aviation task, it may signal an important recognition of a hazard and should not be ignored.

The other two words of TEM's unspoken language — *Whoa!* and *Phew!* — are

the result of *not* recognizing the significance of *Huh?* in identifying a hazard.

Two related processes of perception — *noticing* and *not noticing* — have a direct bearing upon hazard identification. As with TEM's unspoken language, they are deceptively simple but may provide valuable insight into hazard identification.

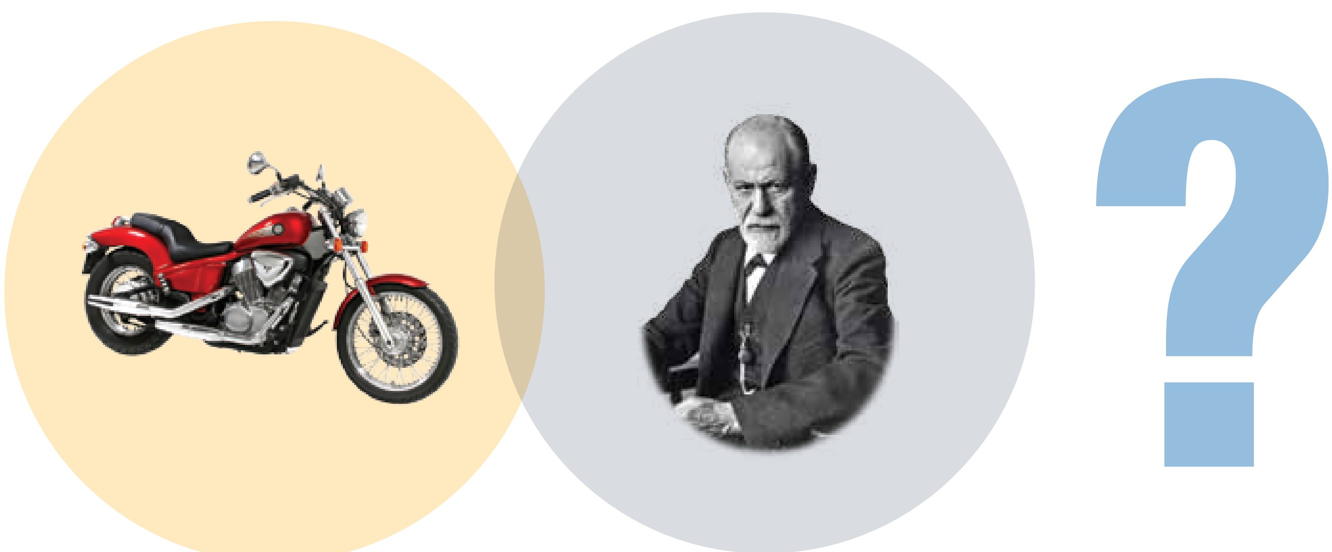
Noticing (The Mini)

An example of *noticing* is the experience that a proud couple (Tom Anthony and his wife) had while trying to decide what kind of car to buy for their daughter, who was returning home after two years of service with the Peace Corps in Honduras. Their discussions led to the Mini Cooper as possibly the best choice.

They were surprised when Minis began to appear everywhere — in the hardware store parking lot, alongside at a traffic light … here and there … *everywhere*. Was there a sudden explosion in the number of Minis in their neighborhood? No. They simply experienced the phenomenon of *noticing*.

They were not consciously looking for Minis, but they were *noticing* them. It was an involuntary act of cognition much like the involuntary recognition in *Huh?*

In his book *Blink: The Power of Thinking Without Thinking*, Malcolm Gladwell cites an even more dramatic example of the subconscious processes of *noticing*.[2] An ancient marble sculpture of a Greek youth purchased for $10 million by a museum came with substantial documentation of authenticity. The director of the museum proudly showed the new treasure to Thomas Hoving, former director of the Metropolitan Museum of Art in New York. After looking over the sculpture, Hoving asked, "Have you paid for this?" He added this advice: "If you haven't, don't. If you have, try to get your money back."



There wasn't a single element of the sculpture that appeared false to Hoving; but, as a whole, the sculpture did not ring true. It ultimately proved to be a forgery produced in the 1980s.

What can this example from the world of art teach us about aviation safety? It is further evidence that, through our experience and training, we build up a library of lessons, some of which we "just can't put our finger on" but are nonetheless real, valuable and not to be ignored.

Not Noticing (The Gorilla)

In their book, *The Invisible Gorilla: And Other Ways Our Intuitions Deceive Us*, Christopher Chabris and Daniel Simons recount an experiment that they conducted in the Harvard University psychology department in the 1980s.[3] A video of the experiment on YouTube shows two commingled teams passing basketballs among themselves. One team is dressed in black uniforms and the other team is dressed in white uniforms.

The viewer is directed to count the number of times the white team members pass the ball to each other. (The correct number is 34.) However, during the one-minute video, a person dressed in a gorilla suit walks into the middle of the game, thumps its chest, walks about and leaves. The gorilla is on camera about nine seconds.

After watching the video, the viewer is asked if he or she noticed a gorilla. Invariably, about half of first-time viewers say that they did not see the gorilla. They did not *notice* the gorilla because they were looking for something else. They were focused on counting the number of times the white-team members passed the ball to each other.

Fatal Not Noticing (Motorcycles)

Analogous findings of a more critical and safety-related nature have been generated from research on motorcycle accidents. For example, Harry Hurt, a professor at the University of Southern California (USC), in landmark research conducted for the U.S. Department of Transportation and published in 1981, found that "the failure of motorists to detect and recognize motorcycles in traffic is the predominating cause of motorcycle accidents."

Hurt explained that "the driver of the other vehicle involved in the collision with the motorcycle did not see the motorcycle before the collision, or did not see the motorcycle until too late to avoid the collision."

Similar findings resulted from the Motorcycle Accident In-Depth Study, conducted in five European countries in 1999 and 2000. The researchers concluded that the lack of evidence of emergency braking or avoidance maneuvers by the drivers of vehicles that struck motorcycles confirmed that the drivers did not see the motorcycles.

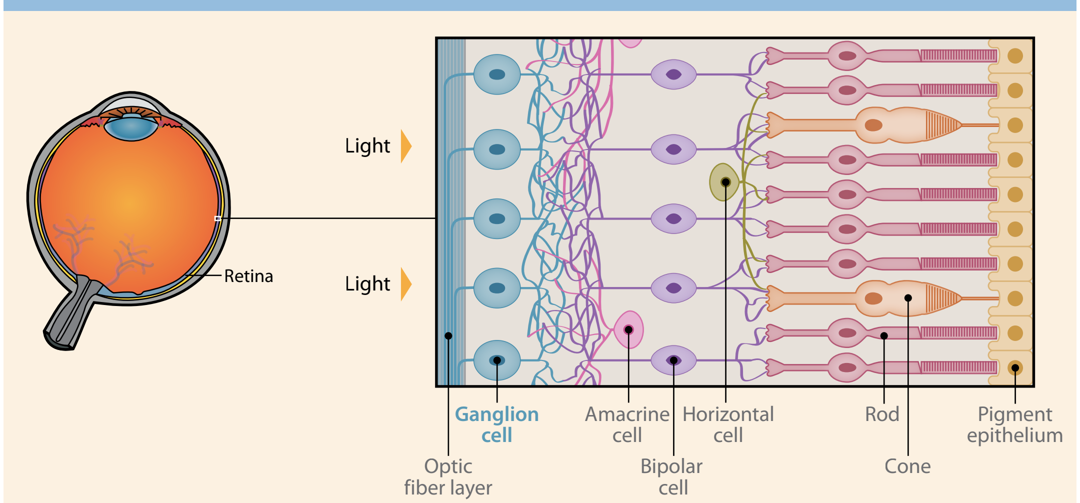
How Much Is Unseen?

The "invisible gorilla" experiment and the motorcycle safety study underscore a fundamental fact: Although light reflected by the gorilla or the motorcycle passes through the lens of the eye and strikes the retina inside the eye, there is no cognition — the objects are *not seen*.

This raises a compound question: How much are we not seeing, and is any of it important? Certainly, the images of the motorcycles were critically important.

As aviation professionals, we want to *notice* hazards and avoid *not noticing* them. Gregg Bendrick of the U.S. National Aeronautics and Space Administration and the USC Aviation Safety Program describes the

Structure of the Retina



Sources: Rhcastilhos/Wikimedia and Susan Reed

Figure 1

hazard-identification functions of the retina as follows: "The retina of the eye has very specific structures within it which function as optical hazard-identification and risk-assessment mechanisms. These are the cones and the rods of the retina. The cones (so named because of their conical shape) are concentrated in the center of the retina. The rods (so also named because of their shape) are dispersed over the wider area of the retina with a much lower level of concentration.

"The cones process visual information for our central vision. The central vision is what we see and are consciously aware of. It is what we are 'looking at.' On the other hand, the rods process information of the peripheral vision. In effect, the rods, which feed our peripheral vision, act as light and motion detectors, as well as a basic horizon indicator.

"We can 'see' things via this peripheral vision but not be consciously aware of them. The peripheral vision helps with our overall spatial orientation, and when a light or relevant motion 'catches our eye,' our brain redirects the eyes to focus the central (cone) vision onto the item of interest. That is, the item is now brought to our conscious level of awareness.

"This duality of vision also allows us to focus on something, like reading a newspaper or viewing an iPod while we are walking. We can do these two things at once, and we may not be conscious of the walking function, nor the general surface of the walkway ahead, though it is being subconsciously processed."

The rods, then, provide a very important *Huh?*-like function. They sense movement and environmental differences, and they act automatically to direct the central vision to focus on the item identified to be of further interest. In a sense, it is a physiological TEM function.

More Than a 'Camera'

In a recent discussion of the retina as a hazard-identification mechanism, Bendrick provided two additional insights that have powerful safety implications and bear upon the question of organizational/individual responsibility.

First, although the retina is located within the eye, it is actually part of the brain. Second, while for years scientists have identified rods and cones as the only significant light-sensing mechanisms within the eye, recent research has identified a third type of light-sensing neurons in the retina: the *intrinsically photosensitive retinal ganglion cells*, which transmit signals to control our circadian rhythms and other photoperiodic functions (Figure 1).

Circadian rhythms have a direct bearing upon our levels of mental awareness and our abilities to *notice* and identify hazards, and our tendency to *not notice*.

So, unlike our earlier conception of the eye (retina) as simply a remote camera that transmits raw data to the brain, where it is processed and analyzed, research has found evidence that the retina also performs the traditional brain functions of processing and storage.

As aviation professionals, we want to *notice* hazards and avoid *not noticing* them.

Sigmund Says

Sigmund Freud, in *The Psychopathology of Everyday Life*, points out that "no person forgets to carry out actions that seem important to himself."[4] Using himself as an example, he claimed an excellent memory but admitted that he sometimes forgot appointments with patients that he was treating at no charge.

Freud underscored this observation with the comment: "What one forgets once, he will forget again."

He also provided a personal insight into peripheral *noticing*: "Both irritating and laughable is a lapse in reading to which I am frequently subject when I walk through the streets of a strange city during my vacation. I then read 'antiquities' on every shop sign that shows the slightest resemblance to the word; this displaying the questing spirit of the collector."

Noticing is the opposite of *forgetting*. It is *uncommanded remembering*. As Freud pointed out, we notice what we are interested in or value; we forget (or do not notice) those things that we see as unimportant or do not value. Our interests reflect our values — those things that we see as important, those things that we see as unimportant.

What role does the organization have in creating the values, and therefore the interests, of its employees?

George S. Patton might have provided the answer when he took command of the U.S. Third Army and addressed its 90th Division as it prepared to go back to the front during World War II. The troops had experienced some rough going prior to Patton assuming command, and their performance had been not wholly successful. Nevertheless, the general let them know that they were the best damned troops in this man's army.

Later, he was asked by an aide if he really thought they were the best. Patton replied that *it was not important that they were the best, it was important that they thought they were.*

Values Affect Perception

These examples demonstrate the role of values in influencing individual perception and performance. Where have we seen the word *values* before? It is in our definition of *organizational culture*: the values, beliefs, roles and behaviors that define the identity of a particular organization and the individuals that function within it.

An organizational culture reflects the values, beliefs and roles expected from employees. It must be established and maintained in a tangible, organized and coherent way in which actions support words. There can be no difference between what leadership says and what it does. The leadership of an organization has the power to create a synergistic organizational culture or a "malergistic" organizational culture rife with negative interaction.

Moreover, an organization cannot expect a high level of personal responsibility from its employees if it does not treat them with respect.

The English poet and artist William Blake said, "A fool sees not the same tree that a wise man sees." Organizations are better served by wise men than by fools, but wisdom is the result of learning, rather than birth. Organizations can create their own "wise men" by valuing learning, sharing and communication. Wisdom is the fruit of understanding, not of rote repetition or blind obedience.

The responsibilities of the individual are significant as well. The primary responsibility of individuals is to perform their jobs to the full extent of their abilities and training, with honesty and without reservation. Individuals must act and communicate in the interest of the organization that employs them.

Inherent in the responsibility to communicate is the recognition that each individual has a valuable role in hazard identification. Without the full participation of employees at all levels in hazard identification, an organization cannot operate safely and productively.

The willingness of the individual to communicate and report honestly reflects directly upon the culture of the organization. The organization must have practices and procedures that value communication and reporting. It must have a *reporting culture* as part of a *learning culture* that enables long-term organizational growth and viability.

Asking Why

Anyone seeking a simple answer to the question of organizational versus individual responsibility is bound to be disappointed. Aviation is a complex, technical and highly evolved environment in which each part has a potential effect or co-dependency upon other parts. It is unrealistic to expect a simple answer when dealing with such a complex and highly evolved system.

What is simple, though, and can be universally expected to produce a true and accurate answer with regard to the world of aviation mishaps is the universal question: *Why?* This question is a tool that, with dedication and application, can produce the most honest and complete explanation of any mishap, whether in the aviation environment or in any other complex technological environment.

Why? is the tool that leads us from impression to answer, from incomplete to complete. It is a tool for correcting underlying causes rather than for satisfying the superficial demands of the moment.

The Mini Cooper, the invisible gorilla, motorcycles, Sigmund Freud, George Patton and the physiology of the eye are diverse sources upon which to draw insights into aviation safety. However, we believe that the insights are valid and valuable. They underscore the complexities of individual perception and the role of organizational culture in creating the values and beliefs that direct and shape our perception of the outside world.

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Chris Nutter is a staff instructor at the USC Aviation Safety and Security Program, and a captain for a major airline.

Notes

1. The article is available at <flightsafety.org>.
2. Gladwell, Malcolm. *Blink: The Power of Thinking Without Thinking*. New York: Little, Brown and Company, 2005.
3. Chabris, Christopher; Simons, Daniel. *The Invisible Gorilla: And Other Ways Our Intuitions Deceive Us*. New York: Random House, 2010.
4. Freud, Sigmund. *The Psychopathology of Everyday Life*. From *The Basic Writings of Sigmund Freud*, translated and edited by Brill, A.A. New York: Random House, 1938.

BY RICK DARBY

Runway Excursions a Continuing Threat

Safety gains in the excursion accident record were reversed in 2010.

Worldwide commercial jet aviation resulted in fewer accidents in 2010 than in 2009, according to data released by Boeing Commercial Airplanes.[1,2] That was the best news in the year-over-year comparisons. However, on-board fatalities jumped from 413 in 2009 to 555 in 2010. The number of runway excursions — veer-offs and overruns — increased by one, and runway excursions as a percentage of all accidents were higher.

A total of 40 accidents occurred in 2010 (Table 1). That represented a 35 percent decrease from 62 the previous year and a 25 percent decrease from 53 in 2008. Eleven accidents were classified as "major" in 2010, compared with 13 in 2009.[3]

Nine of the 2010 accidents were fatal, including one that occurred while the aircraft was stopped on the runway; a passenger later died from injuries sustained during the evacuation.

Six of the eight in-flight fatal accidents in 2010 occurred during the approach and landing phases of flight, compared with four of eight in 2009. The 26 approach and landing accidents accounted for 65 percent of the total accidents, compared with 60 percent in 2009 and 58 percent in 2008.

One of the 13 runway excursion accidents was fatal — the overrun at Mangalore, India, on May 22, which cost 158 lives (*ASW*, 5/11, p. 12). Excursion accidents represented 33 percent of total accidents, compared with 19 percent in 2009 and 30 percent in 2008.

A single accident — a fatal one — occurred during cruise flight in 2010. Seven accidents, of the total of 62, were in the cruise phase the prior year.

Changes from one year to the next can suggest possible trends but are subject to "confounding" factors; for example, the number of fatalities in an accident may be influenced by the number of passengers who happen to be on the flight. Boeing's annual accident summaries provide longer timelines where the data comparisons are likely to be more meaningful, principally differences in accidents since commercial jet aviation began in significant numbers in 1959, and during 10-year study periods.

Viewed in a wider time frame, some improvement is seen. In the 2001–2010 period, there were 4,707 on-board fatalities in scheduled passenger service, compared with 4,938 in 2000–2009, a decrease of 5 percent (Table 2, p. 56). The number of fatal accidents in scheduled passenger service dropped from 69 in 2000–2009 to 67 in the more recent 10-year span. There was one fewer charter operations fatal accident in 2001–2010 than in 2000–2009.

Cargo flights were involved in 15 fatal accidents in the most recent 10 years compared with 14 in the prior 10 years, resulting in 46 on-board fatalities compared with 42. The number of accidents in cargo operations was down in the latest 10-year span, from 81 to 80.

Considering all accidents in the worldwide commercial jet fleet, no change in recent trends appeared in the latest summary. Fatal accidents

2010 Airplane Accidents, Worldwide Jet Fleet

Date	Airline	Model	Accident Location	Phase of Flight	Description	Damage Category	Onboard Fatalities (External Fatalities)	Major Accident?
Jan. 2	Compagnie Africaine d'Aviation	727	Kinshasa, Congo D.R.	Landing	Runway veer-off	Destroyed		●
Jan. 15	Iran Air	F-100	Isfahan, Iran	Landing	Hard landing	Substantial		
Jan. 16	Utair	737-500	Moscow	Taxi	Nose landing gear collapse	Substantial		
Jan. 19	Mexicana Airlines	A318	Cancun, Mexico	Takeoff	Fan cowling torn off	Substantial		
Jan. 25	Ethiopian Airlines	737-800	Near Beirut, Lebanon	Climb	Struck Mediterranean Sea after takeoff	Destroyed	90 (0)	●
Jan. 30	Spring Airlines	A320	Shenyang, China	Landing	Tail strike	Substantial		
Feb. 6	SAS	MD-82	Grenoble, France	Landing	Tail strike	Substantial		
Feb. 11	Click Mexicana	F-100	Monterrey, Mexico	Landing	Runway veer-off	Substantial		
Feb. 13	Southwest Airlines	737-700	Near Santa Clarita, California, U.S.	Approach	TCAS avoidance maneuver injured flight attendant			
March 1	ACT Airlines	A300-B4	Bagram, Afghanistan	Landing	Landing gear collapse	Substantial		
March 1	Air Tanzania	737-200	Mwanza, Tanzania	Landing	Runway veer-off	Substantial		
March 4	China Airlines	747-400	Anchorage, Alaska, U.S.	Takeoff	Tail strike	Substantial		
March 4	Cobham Aviation Australia	717	Ayers Rock, Australia	Parked	Flight attendant fell from airplane			
April 2	EgyptAir	A330	Cairo, Egypt	Taxi	Struck two light poles	Substantial		
April 2	Southwest Airlines	737-300	Los Angeles	Pushback	Struck baggage cart	Substantial		
April 13	Merpati Nusantara Airlines	737-300	Manokwari, Indonesia	Landing	Runway overrun	Destroyed		●
April 13	AeroUnion	A300-B4	Near Monterrey, Mexico	Approach	Struck ground	Destroyed	5 (1)	●
May 12	Afriqiyah Airways	A330	Near Tripoli, Libya	Approach	Struck ground	Destroyed	103 (0)	●
May 22	Air India Express	737-800	Mangalore, India	Landing	Runway overrun	Destroyed	158 (0)	●
June 5	US Airways	A321	Charlotte, North Carolina, U.S.	Parked	Struck by another taxiing airplane	Substantial		
June 6	Royal Air Maroc	737-400	Near Amsterdam, Netherlands	Initial climb	Bird strike	Substantial		
June 21	Hewa Bora Airways	MD-82	Kinshasa, Congo D.R.	Takeoff	Runway veer-off	Substantial		
July 27	Lufthansa Cargo	MD-11	Riyadh, Saudi Arabia	Landing	Runway veer-off	Destroyed		●
July 28	AirBlue	A321	Near Islamabad, Pakistan	Approach	Struck hillside	Destroyed	152 (0)	●
July 28	Mauritania Airways	737-700	Conakry, Guinea	Landing	Runway overrun	Substantial		
Aug. 12	Azerbaijan Airlines	A319	Istanbul, Turkey	Landing	Runway overrun	Substantial		
Aug. 16	Aires Colombia	737-700	San Andres Island, Colombia	Landing	Landing short	Destroyed	2 (0)	●
Aug. 20	Chanchangi Airlines	737-200	Kaduna, Nigeria	Landing	Landing short	Substantial		
Aug. 24	Henan Airlines	EMB-190	Yichun, China	Final approach	Landing short	Destroyed	42 (0)	●
Aug. 26	Iran Aseman Airlines	F-100	Tabriz, Iran	Landing	Runway overrun	Substantial		
Sept. 3	UPS	747-400	Near Dubai, United Arab Emirates	Cruise	In-flight fire	Destroyed	2 (0)	●
Sept. 6	easyJet	A320	London	Parked	Struck by truck	Substantial		
Sept. 24	Wind Jet	A319	Palermo, Italy	Landing	Runway veer-off	Substantial		
Sept. 25	Atlantic Southeast Airlines	CRJ-900	New York	Landing	Gear failed to extend	Substantial		
Oct. 3	Thomsonfly	767	Bristol, England	Landing	Hard landing	Substantial		
Oct. 31	Turkish Airlines	A310	Casablanca, Morocco	Landing	Runway veer-off	Substantial		
Nov. 2	Lion Air	737-400	Pontianak, Indonesia	Landing	Runway overrun	Substantial		
Nov. 4	Global Air	737-200	Puerto Vallarta, Mexico	Landing	Nose landing gear retracted	Substantial		
Nov. 4	Qantas Airways	A380	Near Batam Island, Indonesia	Climb	Uncontained engine failure	Substantial		
Nov. 10	Kuwait Airways	A300-600	Kuwait City	Parked	Evacuation	—	1 (0)	
	Total accidents: 40					**Totals**	**555 (1)**	**11**

TCAS = traffic-alert and collision avoidance system

Source: Boeing Commercial Airplanes

Table 1

were reduced from 89 in 2000–2009 to 87 in 2001–2010. All accidents increased from 393 to 399, respectively.

In accidents from 2001 through 2010, 87, or 22 percent, were fatal (Figure 1). For 2000–2009, the equivalent figure was 23 percent; for 1999–2008 and 1998–2007, 25 percent each. From 1959 through 2010, 34 percent of accidents were fatal.

The most recent 10-year period included 180 substantial damage accidents with no fatalities, representing 45 percent of all accidents. Among non-fatal accidents, 4.5 percent involved no substantial damage but serious injuries in 2001–2010. In the 1959–2010 stretch, the corresponding percentage was 4.9 percent.

For 1959 through 2010, 88 fatal accidents — 15 percent of fatal accidents — occurred in the absence of substantial damage. For 2001 through 2010, the percentage was the same.

Scheduled commercial passenger operations had a fatal accident rate of 0.40 per million departures in 2001–2010. All other operations, including categories such as charter passenger, charter cargo, maintenance test and training, had a fatal accident rate of 0.67 per million departures.

Boeing has adopted the practice of tabulating fatalities according to the standardized taxonomy of the U.S. Commercial Aviation Safety Team/ International Civil Aviation Organization

Accidents, Worldwide Commercial Jet Fleet, by Type of Operation

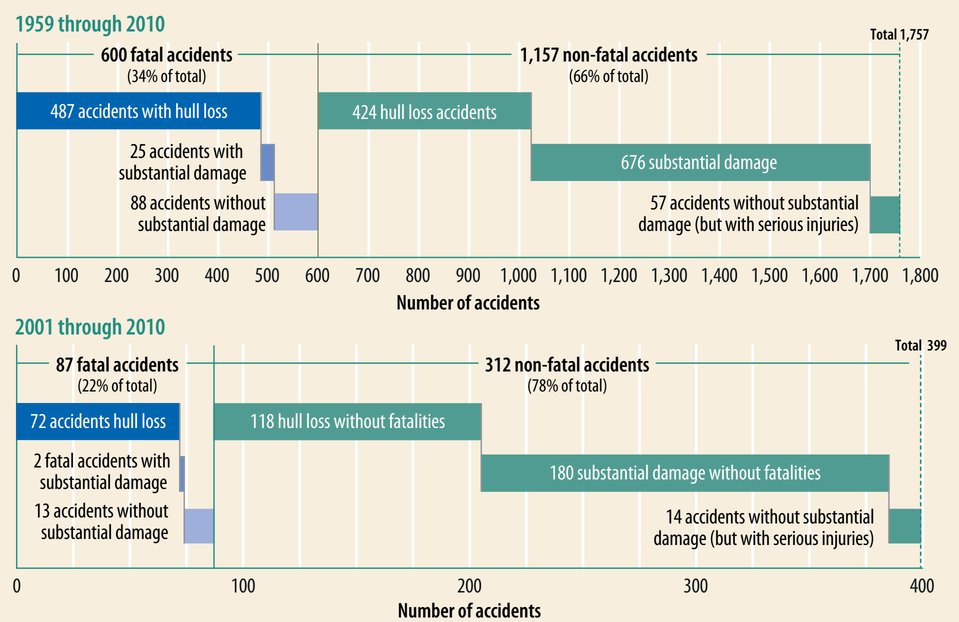
Type of operation	All Accidents 1959–2010	All Accidents 2001–2010	Fatal Accidents 1959–2010	Fatal Accidents 2001–2010	On-board Fatalities (External Fatalities)* 1959–2010	On-board Fatalities (External Fatalities)* 2001–2010
Passenger	1,390	308	481	69	28,381 (777)	4,711 (157)
Scheduled	1,276	287	436	67	24,267	4,707
Charter	114	21	45	2	4,114	4
Cargo	250	80	75	15	262 (330)	46 (74)
Maintenance test, ferry, positioning, training and demonstration	117	11	44	3	208 (66)	17 (0)
Totals	**1,757**	**399**	**600**	**87**	**28,851 (1,173)**	**4,774 (231)**
U.S. and Canadian operators	541	75	178	12	6,158 (381)	265 (15)
Rest of the world	1,216	324	422	75	22,693 (792)	4,509 (216)
Totals	**1,757**	**399**	**600**	**87**	**28,851 (1,173)**	**4,774 (231)**

*External fatalities include ground fatalities and fatalities on other aircraft involved, such as helicopters or small general aviation airplanes, that are excluded.

Source: Boeing Commercial Airplanes

Table 2

Accidents, by Injury and Damage, Worldwide Commercial Jet Fleet



Source: Boeing Commercial Airplanes

Figure 1

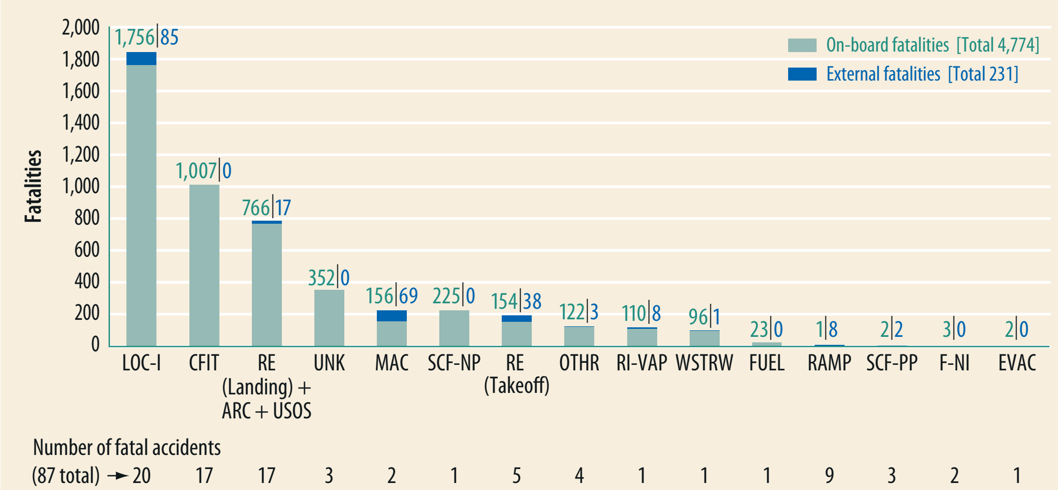
(CAST/ICAO).[4]

For the most recent 10-year study period, "loss of control in flight" (LOC-I) and "controlled flight into terrain" (CFIT) were the categories with the greatest number of on-board fatalities (Figure 2). The LOC-I on-board fatalities, numbering 1,756, were almost unchanged from 2000–2009. The on-board loss of life from CFIT accidents, however, which totaled 961 in 2000–2009, was greater in the latest period at 1,007.

The third greatest number of on-board fatalities in 2001–2010 was amalgamated by Boeing as "runway excursion (RE) landing" combined with "abnormal runway contact" (ARC) and "undershoot/overshoot" (USOS). The on-board fatalities, 766, in the latest 10-year time frame were higher than those in the previous 10-year tally, 606. The equivalent number in 1999–2008 was 408.

There was no increase in on-board fatalities from runway excursions on takeoff between 2001–2010 and 2000–2009: 154 on-board fatalities, 38 external fatalities.

Fatalities by CAST/ICAO Taxonomy Accident Category, Worldwide Commercial Jet Fleet, 2001–2010



CAST = U.S. Commercial Aviation Safety Team; ICAO = International Civil Aviation Organization; ARC = abnormal runway contact; CFIT = controlled flight into terrain; EVAC = evacuation; F-NI = fire/smoke (non-impact); FUEL = fuel related; LOC-I = loss of control – in flight; MAC = midair/near midair collision; OTHR = other; RAMP = ground handling; RE = runway excursion; RI-VAP = runway incursion – vehicle, aircraft or person; SCF-NP = system/component failure or malfunction (non-powerplant); SCF-PP = system/component failure or malfunction (powerplant); UNK = unknown or undetermined; USOS = undershoot/overshoot; WSTRW = wind shear or thunderstorm.

No accidents were noted in the following principal categories: aerodrome, abrupt maneuver, air traffic management/communications, navigation, surveillance, bird strikes, cabin safety events, fire/smoke (post-impact), ground collision, icing, low altitude operations, loss of control – ground, runway incursion – animal, security related or turbulence encounter.

Note: Principal categories are as assigned by CAST. Airplanes manufactured in the Russian Federation or the Soviet Union are excluded because of lack of operational data. Commercial airplanes used in military service are also excluded.

Source: Boeing Commercial Airplanes

Figure 2

Notes

1. Boeing Commercial Airplanes. *Statistical Summary of Commercial Jet Airplane Accidents: Worldwide Operations 1959–2010.* June 2011. <www.boeing.com/news/techissues/pdf/statsum.pdf>.
2. The data are limited to commercial jet airplanes over 60,000 lb (27,216 kg) maximum gross weight. Airplanes manufactured in the Soviet Union or Commonwealth of Independent States are excluded because of the lack of operational data.

   An airplane *accident* is defined as "an occurrence associated with the operation of an airplane that takes place between the time any person boards the airplane with the intention of flight and such time as all such persons have disembarked, in which death or serious injury results from being in the airplane; direct contact with the airplane or anything attached thereto; or direct exposure to jet blast; the airplane sustains substantial damage; or the airplane is missing or completely inaccessible." Occurrences involving test flights or hostile action such as sabotage or hijacking are excluded.
3. Boeing defines a *major* accident as one meeting any of three conditions: the airplane was destroyed; there were multiple fatalities; or there was one fatality and the airplane was substantially damaged.
4. The taxonomy is described at <www.intlaviationstandards.org>.

Before and After

Fatigue-inducing pilot stress does not occur only in the cockpit.

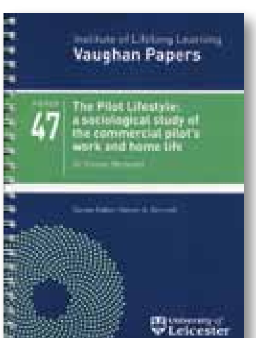
BY RICK DARBY

BOOKS

'Tired All the Time'

The Pilot Lifestyle: A Sociological Study of the Commercial Pilot's Work and Home Life

Bennett, Simon. Leicester, England: University of Leicester Institute of Lifelong Learning, 2011. 228 pp.



"Didn't get to sleep until 2300. Woke at 0100 and stayed awake until 0400. Then slept until 0800. [At] work by 0900 to pick up taxi to LBA [Leeds-Bradford Airport, England]. Ninety-minute ride. Flight delayed one hour due to late inbound. Operated LBA-PMI-MAN [Leeds-Bradford–Palma de Mallorca, Spain–Manchester, England]. Flight delayed PMI by one hour due to flow-control restrictions. No meal on return flight — oven unserviceable — so starving. Two hours late into MAN. Drove home. Quick chat to wife, then bed at 2230 with sleeping tablet — I need to get some sleep."

Many corporate managers work long hours and travel often. It is hard to imagine a company, however, that would expect a high-level executive to keep a schedule like the one above *regularly*, every working day and/or night.

But it was a manager with a great deal of responsibility, an airline captain, who wrote that description of his workday. It is quoted from the diary he kept during the busy summer charter-flight period, as one of about 130 pilots who recorded in detail their experiences in the cockpit, at airports, at hotels and at home.

Bennett, who conducted the study and analyzed the responses, says, "In 2010, the British Air Line Pilots' Association's members perceived a need to document the pilot lifestyle. Sociology, with its ability to 'get behind the story,' seemed the ideal investigative tool. … In essence, this report is an oral history of the modern pilot experience."

Bennett used three research instruments to understand and analyze the commercial pilot lifestyle. The first was a sleep/activity log, or SLOG, kept for 21 days by pilots in the study. "More textured than a simple sleep log, it recorded pilots' *lived reality* of work and home," he says. Completed SLOGs, which ranged in length from about 2,000 to 9,000 words, were confidential and de-identified. The study began in mid-2010 and ended in 2011.

Interviews and a Web-based questionnaire supplemented the SLOGs. In addition, "useful data emerged via an unexpected route: Many of the diarists provided information in emails and letters," Bennett says.

Each published diary is followed by Bennett's analysis, often including findings from other researchers, which are keyed to end notes. For the sake of brevity, details of the citations are omitted in the following examples.

From the diary of another captain on long-haul flights:

Day 1. "Woke at 0610. [All times in this and other diary excerpts are coordinated universal time to clarify the durations in the sequences.] Preflight sleep 1130–1245. Felt well rested. Departed by car for base at 1400. Arrived 1630. (Drive to work took 2.5 hours.) Pushed 1930 for LHR-EWR [London Heathrow to Newark, New Jersey, U.S.]. In-seat sleep for 45 minutes."

Day 2. "[I was] pilot flying for arrival. On blocks 0330. Felt absolutely whacked by the time I boarded the crew bus. Crew bus to Manhattan hotel accommodation. Checked in by 0530. Asleep by 0630. Slept until 1025, then restless sleep until 1330."

Day 7. London Heathrow to HGK (Hong Kong). "No Upper Class seat available for in-flight sleep, so resorted to bunk. Three-and-a-half-hour rest break. There was an extra duvet available, so I slept unusually well."

Day 9. "Pushed 1130 for HGK-SYD [Sydney, Australia]. Two-and-a-half-hour rest break taken in Upper Class seat. The flight service manager warned me she would need the seat if we hit turbulence, as one of the passenger seat belts was defective. Aware of this prospect, I never slept at all, really. I kept waking up when we hit turbulence, anticipating a seat-swap. My eyes were stinging as the sun started to come up during our approach into Sydney."

Day 12. "Woke at 0500 after a good sleep (eight hours). Socialized, then retired at 1830. I slept well at first, but an incoming crew decided to hold a party in the room above mine."

Excerpts from Bennett's analysis:

"The diarist seems to have benefited from quiet and relaxing hotel accommodations, with the exception of the room party incident in HKG. Hotel life [has] its irritations. Hotels can be noisy during the day: rooms are cleaned, goods are delivered, guests are dispatched and maintenance is done. Unfortunately, the noise starts just when pilots are getting ready for bed."

"The diarist lived roughly a two-and-a-half-hour drive from LHR, his base. On landing, he would drive home. … Transport Canada says, 'Driving to and from work when fatigued should be considered a hazard. This is increasing in importance as commute times continue to grow significantly longer. You will always be at risk of falling asleep if you are driving while tired or sleep-deprived.'"

"Generally, the diarist seemed able to obtain preflight and in-flight sleep. The Upper Class seat episode on Day 9 illustrates the importance of undisturbed, stress-free sleep opportunities. This was manifestly not a stress-free sleep opportunity. The [U.S.] Federal Aviation Administration comments: 'Sleep should not be fragmented with interruptions. In addition, environmental conditions, such as temperature, noise and turbulence, impact how beneficial sleep is, and how performance is restored.'"

A first officer preparing for duty on a long-haul flight — Munich, Germany (MUC) to Los Angeles (LAX) to MUC — wrote in his diary:

Day 3. "Leave day. Kids woke me up at 0445. Felt all right. Usual morning tasks. Get kids ready, breakfast. Went to town [Düsseldorf; DUS]. Packed suitcase and prepared for the trip until lunchtime. The wife was angry at me leaving — had a little fight about that. Family took me to the airport at 1400. Flight from DUS to MUC. Arrive 1700. Rented a car and drove to the hotel. Arrived 0815. Had dinner at 1900. Did some preparation/reading for the trip. Went to bed at 2045 and fell asleep around 2100."

Day 13. "I slept from 2400 to 0300 [in the aircraft on a flight to São Paulo, Brazil]. I felt tired afterwards — but well enough to fly the last four hours of the flight. I landed the aircraft. We landed well ahead of schedule and were on blocks at 0750. We drove to the hotel and I finally got to bed at 1000. I slept until 1200. I did not feel rested afterwards. … Since [fellow crewmembers] wanted to meet for dinner, I decided to take a nap from 1800 to 2000 and slept from 1830 to 2000. I did not feel well afterwards. I went to the bar where we had arranged to meet and had my first drink of the evening, bought by my captain — so I couldn't say no. I didn't really want to drink alcohol, though. We spent the rest of the evening (2200–0030) in a steak restaurant. I couldn't eat much because of the time of day. It was too late for me."

Excerpts from Bennett's analysis:

'Sleep should not be fragmented with interruptions.'

Hassles with preflight and post-flight transportation are a running thread through the diaries.

"There is strong evidence here of how offspring impose routine on parents. The diarist (and his partner, of course) were locked into a routine of going to bed around 2100 and getting up at between 0500 and 0600. There is also strong evidence of this being a tight-knit family unit with lots of time spent together when the diarist was at home. Young families are demanding. Perhaps it was the prospect of having to cope alone that caused the minor spat prior to the MUC-LAX-MUC trip."

"The diarist had a time-consuming and potentially arduous commute to work. For example, his Day 3 commute to the pre-LAX hotel accommodation by family car, aircraft and rented car took over four hours. After returning from São Paulo, the diarist spent five and a half hours commuting by aircraft, train and bus to his home. … The greater the number of transport interfaces — for example, between an air service and a train or bus service — the greater the chance of missing a connection and of being late for report. Short, single-mode commutes enhance operational resilience."

"In their paper 'The Mental Health of Pilots: An Overview,' Bor, Field and Scragg investigate the link between social or peer pressure and alcohol consumption amongst commercial pilots: 'Pilots experience high levels of stress in their jobs and have to endure considerable disruption to their personal lives. Intermittent absences from family and social support, periods of time relaxing and recuperating, sometimes accompanied by boredom and social pressure to consume alcohol with fellow crewmembers, may be the root cause of alcohol misuse and dependency.'"

Hassles with preflight and post-flight transportation are a running thread through the diaries. Here is a captain for a charter airline after a flight from Cuba to Manchester:

"Into the [hotel] for a sleep of five hours and then back to LGW [London Gatwick] by coach at 1515. The coach is 30 minutes late and is going via Birmingham Airport, which means we don't get back to LGW until 2130, and after a 20-minute walk and transit ride to my car I get home at 2230, tired and with a headache. After completing a night flight, stop-start coach travel is very unpleasant."

The captain sent an email to Bennett along with his SLOG: "Thank you for undertaking what I view to be a critical piece of research. There has been a change in many airlines from a faintly paternalistic ethos to hard-nosed commercialism. This is reflected in their short-term behavior, which is only to the detriment of flight safety. Fatiguing rosters are far more prevalent now than at any time I can remember. It has become a major topic of conversation in our [flight crew] community. This is the first year in my career of 16 years that I have filed a fatigue report.

"I have noticed an increase in the use of sleeping tablets among crew (I don't use them). These are not necessarily prescribed, as they are available in some of our more esoteric destinations."

In Bennett's analysis, he cites his own study of the sleeping habits of "back of the clock" cargo flight crews, in which he found that "although the majority tried to get pre-report, top-up sleep, they were often thwarted by their body clock or other factors, like noise."

The fatigue issue arises in report after report in the pilot lifestyle book. Here is a typical example, from a first officer working for a German carrier: "Right now many pilots in my company are flying overtime and many say that it can't go on. We usually fly five days in a row, have two days off, flying again for five days, etc. Many times we have four or five legs a day, and to top it off, in Frankfurt we have many aircraft changes — meaning we arrive in Frankfurt, have to hurry to finish up the paperwork, shut down the aircraft, lug our baggage out of the aircraft, hop on a crew bus which takes us to another aircraft, lug our baggage to the new aircraft, do all the checks to turn the aircraft on again, etc. All this leads to many of us being tired all the time."

The overall impression obtained from reading many of the 21-day diaries is that the pilots — perhaps encouraged by being asked to report their experience — were aware of their physiological and psychological states. They were not supermen or superwomen. They were affected by the same problems, anxieties and irritants as people in more "routine" occupations, plus additional ones related to frequent long-haul flying, such as the disorientation caused by being unsynchronized with local times.

But it is equally clear that the pilots made a disciplined effort to do whatever it took to compensate for stress and find their balance. They phoned home, found ways to amuse themselves and relax as much as possible under the circumstances, and above all tried — albeit not always successfully — to get enough sleep.

According to Bennett's Web-based questionnaire, 74.4 percent of the respondents answered "yes" to the question, "Have you ever commenced a duty [period] knowing you were fatigued?" A larger percentage, 86.1 percent, acknowledged flying a sector knowing they were fatigued.

The questionnaire asked, "What is the longest period of continuous wakefulness (in hours, from waking up to setting the brakes at the end of the last sector) you have experienced at work?" Replies were "up to 17" hours from 13.9 percent of the pilots; "18–22" from 32.6 percent; "23–27" from 33.3 percent; and "28 or more" from 20.3 percent.

Although some pilots criticized company scheduling policies, 84.3 percent said they had failed to get adequate rest at home before reporting for duty. The most frequent reasons given were family-related stress, work-related stress, household noise and extraneous noise.

Bennett concludes, "Although subjective, pilots' responses to questions about fatigue and stress should give cause for concern. … One remarked: 'I don't want to [quit] flying particularly. But I wake up some days and I ask, "For how much longer can I do this when I feel this tired?"' Such sentiments do not bode well for the industry. An airline's safety performance is influenced in part by its organizational memory, the sum of employees' wisdom and experience. Inevitably, airlines with a high pilot turnover have a weaker organizational memory in terms of flying operations than those with a low turnover. Airlines allow the experience pool to evaporate at their peril."

SMS as Seen by Practitioners

Implementing Safety Management Systems in Aviation

Stolzer, Alan J.; Halford, Carl D.; Goglia, John J. (editors). Farnham, Surrey, England, and Burlington, Vermont, U.S.: Ashgate, 2011. 464 pp. Figures, tables, index.

The editors' earlier book, *Safety Management Systems in Aviation*, was largely concerned with explaining safety management system (SMS) concepts (*ASW*, 12/08, p. 54). This time, their book differs in emphasis and format. It is concerned above all with practical SMS implementation. And whereas the earlier work was written by the present editors, here they have assembled stand-alone chapters by industry specialists who have put SMS into practice.

"While the editors are involved in industry, consulting and academia, we thought that turning to the day-to-day practitioners of SMS provides yet another perspective for the student of SMS," the editors say. "Our authors are among the most experienced practitioners in the industry today."

SMS is still evolving as it translates from theory to practice. The authors of the 14 chapters write from their own viewpoints, and the editors say they are more concerned with conveying the breadth of the subject than reconciling the individuals' outlooks into a systematic treatment.

The book begins with a prologue about a fictional fatal runway collision between a corporate jet and a "Quest Airlines" aircraft, as both companies' management teams review their SMS and its prior implementation.

Subsequent chapters examine SMS from various angles. Some headings are "Perspectives on Information Sharing"; "Top Management Support"; "Safety Culture in Your Safety Management System"; "Integrating SMS Into Emergency Planning and Incident Command"; and "Safety Promotion."

The chapter titled "Practical Risk Management," by Kent Lewis, offers an example of the book's material. Lewis says, "The goal of SMS is to prevent loss of life and property while conducting daily operations, and this is accomplished by the detection and mitigation of hazards. Risk management forms the foundation for an effective SMS, regardless of size, 'With [the Navy's] risk-management model, when a severe hazard was discovered, a report had to be generated to notify the appropriate-level risk managers within 24 hours.'

mission or resources of the organization, team or individual."

After outlining several operational risk reduction models, Lewis looks at case studies of hazards and actual incidents and accidents.

For example, in a near midair collision between a U.S. Navy T-34C training aircraft and a civilian aircraft, "the identified hazard was the lack of a radio [in the military airplane] that operated on civilian frequencies. … With [the Navy's] risk-management model, when a severe hazard was discovered, a report had to be generated to notify the appropriate-level risk managers within 24 hours. This report also included recommendations for corrective actions that were generated with input from the squadron's instructor pilots."

Within a reasonable time, money was appropriated to equip the entire fleet of T-34Cs with dual-band radios. "The total cost of the retrofit was under $2 million and, because the trainer was not a combat aircraft, a commercial off-the-shelf system was immediately available," Lewis says.

Another case study was a Bombardier Canadair CL-600 that overran the departure end of the runway after landing in deteriorating weather, with substantial damage to the aircraft but no injuries to the occupants.

"There were many situational hazards present during this operation, and the confluence of these factors resulted in a mishap," Lewis says. "Just by reading the terse description of the mishap from the [U.S. National Transportation Safety Board] probable cause statement, we begin to see the precursors — the latent conditions that existed before the crew reported to the airport for duty, and in the case of pilot flight time and duty time regulations, existed even before the captain or first officer were born. … We have a low-time first officer on day two of line flying, with the crew approaching both the 16-hour duty day and eight-hour flight-time limit, planning a flight into an airport that had battled weather conditions throughout the evening and into the early hours of the morning. …

"We need also to consider the fact that the runway is relatively short for air carrier operations, 6,500 ft [1,981 m] … . And just to round out the evening's festivities, the air traffic control tower was closed and braking action reports would have to be relayed to the inbound aircraft by airport operations personnel."

All of those hazards were known before the accident, Lewis notes.

"With all of this information in hand, a time-critical risk assessment could be conducted and most likely it would score in a category that required actions be taken to reduce the level of risk," he says. "There are many examples of risk-assessment matrices and personal minimum checklists available for use." [The *FSF Approach and Landing Accident Reduction Tool Kit Update* <flightsafety.org/current-safety-initiatives/approach-and-landing-accident-reduction-alar/alar-tool-kit-cd> includes an approach and landing risk awareness tool, a controlled flight into terrain risk assessment checklist, and other risk assessment and mitigation contents.]

"Risk control recommendations should address short-term, mid-term and long-term solutions, and investigators should do so without consideration to cost," Lewis says. "This is not because cost is not an issue, but because the cost is an issue that should be decided at the appropriate level. Many times, the recommendations offer long-term cost savings benefits because the hidden costs of a mishap can be three to five times the visible costs of a mishap. There may be damage to the environment; loss of trust and, subsequently, revenue in a customer base; reduction in revenue from loss of assets; civil and criminal legal fees; and awards and potential fines from a regulator.

"Investigative teams can be exercised by participating in the risk management process; there is no need to wait for loss of life or damage to property."

REPORTS

Addressing Capability Issues

Civil Aviation Authority Safety Plan 2011 to 2013

U.K. Civil Aviation Authority (CAA). IN-2011/090. Aug. 26, 2011. 46 pp. Available online at <www.caa.co.uk/docs/978/CAA_Safety_Plan_2011.pdf>.

The CAA Safety Plan is an element of the CAA Strategic Plan, whose objective is "to enhance aviation safety performance by pursuing targeted and continuous improvements in systems, culture, processes and capability."

The plan's initiatives are of two types.

First, "we are taking action to address the factors behind the most significant worldwide accident types involving large airliners — we call these the 'Significant Seven' — as well as actions for other sectors, such as business aviation, large public transport helicopters and general aviation."

Second, "we are taking action to address 'capability issues.' We believe that enhancing our safety risk management systems and adoption of a performance-based regulatory approach will improve the way the CAA regulates and will result in safety improvements of benefit to aviation and the public at large by focusing on the right risks."

The Significant Seven factors are loss of control, runway excursions, controlled flight into terrain, runway incursions, airborne conflict and ground handling. Some findings of a CAA task force report on the status of the seven was described in *ASW* (4/11, p. 50).

The report says, "One of the target outcomes from the CAA Strategic Plan is that 'the U.K. aviation industry and the CAA will have measurably increased capability and performance in safety management, human factors and just culture, and demonstrated the benefits in terms of risk reduction.'"

Key capability issues' intended outcomes are discussed under the following headings.

Integrated safety risk management process. "Develop a new integrated safety risk management process to allow more effective monitoring and management of aviation safety risk by the CAA and industry."

Safety management systems (SMS). "Improve the safety performance of organizations through the implementation of effective SMS and the CAA's capability to assess the effectiveness and safety performance of an organization's SMS."

Just culture. "To achieve a balance between the interests of safety (e.g., protection of safety information) whilst not tolerating recklessness, and to achieve improvements in the open reporting of safety occurrences in parts of the industry where it is currently lacking."

Continuing airworthiness. "Improve the CAA's capability to extract intelligence from all sources of airworthiness-related safety data, so that the associated risks are better understood and the most effective actions to mitigate them can be identified and implemented."

Strategy for human factors (HF). "A better understanding of human performance, limitations, attitudes and behaviors to drive the practical application of human factors principles in reducing risk within the aviation safety system."

Performance-based oversight. "Deliver effective regulation in a manner and at times which have the greatest impact on preventing significant aviation losses. Facilitation of proportionate, targeted and consistent regulation."

Fatigue risk management systems (FRMS). "Deliver effective regulatory oversight of fatigue management using FRMS techniques and metrics, proportionate to the size and complexity of the operational environment. To ensure that safety-critical workers are able to operate at an effective level of alertness for all normal and abnormal circumstances."

The report also notes "total system threats" such as the volcanic ash crisis of 2010 — an example of an improbable event whose knock-on effects can temporarily cripple the entire aviation system. Reviewing lessons learned from the ash cloud debacle revealed that "one of the CAA's strengths … was its ability to draw upon internal expertise based on a long involvement in relevant issues and previous incidents. The need to retain such capability is reflected in the CAA Strategic Plan, together with the need for continued improvement in the CAA's expertise, plans and processes for crisis management, and the ability to better identify and prevent or prepare for rare but high-impact events."

Ice Blocks A330 Pitot Probes

Airspeed data discrepancies triggered disengagement of the autoflight systems in two airplanes.

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

Fly-by-Wire Protections Degraded

Airbus A330s. No damage. No injuries.

Ice crystals blocked the pitot probes on two Airbus A330s that were cruising at high altitudes in the vicinity of convective weather activity, causing erroneous airspeed indications and reduced autoflight systems operation, according to a report issued in June by the U.S. National Transportation Safety Board (NTSB).

The incidents reported by NTSB involved an A330-200 of Brazilian registry that was en route with 176 people aboard from Miami to São Paulo, Brazil, on May 21, 2009, and an A330-300 of U.S. registry that was en route with 217 people from Hong Kong to Tokyo on June 23, 2009.

"Crew statements and recorded data for both flights did not indicate any airplane anomalies prior to the events," the report said.

The Brazilian airplane was at Flight Level (FL) 370 (approximately 37,000 ft) over Haiti when the flight crew noticed an abrupt decrease in outside air temperature and observed St. Elmo's fire, a coronal discharge of plasma that produces a faint flame-like glow on an aircraft flying through an electrically charged atmosphere. The airplane's air data reference system ceased operating, primary displays of airspeed and altitude were lost, the autopilot and autothrottle disengaged, and the fly-by-wire system reverted from normal control law to alternate control law, which provides fewer protections against exceeding performance limitations.

"The flight crew continued using backup instruments," the report said. "After approximately five minutes, primary data was restored. … The crew determined they could not restore normal law and continued the flight under the appropriate procedures." The airplane was landed in São Paulo without further incident.

In the second incident, the crew of the U.S. airplane was using the on-board weather radar system to avoid thunderstorms while flying over Japan at FL 390. However, "just prior to the event, the airplane entered an area of cirrus clouds with light turbulence and moderate rain, with a brief period of intense rain and hail aloft," the report said.

The autopilot and autothrottle disengaged, fluctuating airspeed indications were displayed, and a stall warning was generated. The crew "reported that the airspeed fluctuations and warnings lasted about one minute, and they controlled the airplane by pitch and power reference, per applicable checklist procedures, until normal airspeed indications returned," the report said.

Airspeed fluctuations occurred again briefly as the crew turned the airplane farther away from the convective activity. After about two minutes, "the airspeed indicators returned to normal, and the crew re-engaged the autopilot and completed the flight in alternate [control] law," the report said.

Investigators determined that the incidents were initiated when at least two of the three pitot probes on each airplane were blocked by an accretion of ice crystals.

The electrically heated pitot probes measure total air pressure, which is converted by three air data modules (ADMs) into electronic signals that are used — along with static pressure measured by the airplane's static ports — by three associated air data inertial reference units to calculate airspeed. The data generated by the ADMs are compared by independent flight control computers that disengage autoflight systems and adjust the flight control law if discrepancies exceed programmed limits.

A330s originally were equipped with Goodrich 0851GR pitot probes. "In 2001, following some inconsistent speed problems, Airbus replaced the original 0851GR probes with either Goodrich 0851HL probes or Thales [C16195QAA] probes," the report said. "Operators had the option to install either of those probes in any location and could have any mix of both types on the same airplane."

The Thales "AA" probes have been found to be more susceptible to high-altitude ice crystal icing than other approved probe designs. In 2007 and 2008, Airbus recommended that A330 operators replace any AA-series probes with Thales C16195BA ("BA") probes. Tests performed by Thales in an icing wind tunnel have shown that the BA probes are more resistant than the AA probes to blockage.

The European Aviation Safety Agency (EASA) and the U.S. Federal Aviation Administration in August 2009 issued airworthiness directives requiring the replacement of all AA probes on A330s and A340s. The directives required Goodrich 0851HL probes at the no. 1 (captain's) and no. 3 (standby) positions, and either a 0851HL probe or a Thales BA probe at the no. 2 (first officer's) position.

The NTSB report discussed two other occurrences — an accident and an incident — involving "unreliable airspeed events" in A330s. The accident, which is being investigated by the French Bureau d'Enquêtes et d'Analyses (BEA), occurred on June 1, 2009, when an A330-200 — Air France Flight 447 — equipped with Thales AA probes descended into the Atlantic Ocean during a flight from Rio de Janeiro, Brazil, to Paris. All 228 people aboard the airplane were killed. Based on preliminary findings, the BEA has called on EASA to review icing-certification standards for pitot probes.

EASA in August proposed an airworthiness directive that would require A330/340 flight control computer software changes to prevent re-engagement of autoflight systems with unreliable airspeed data.

The incident cited by the NTSB report involved an A330, equipped with Goodrich 0851HL pitot probes, near Guam on Oct. 28, 2009. The incident was investigated by the Australian Transport Safety Bureau (ATSB), which reported in January 2011 that the flight crew had been maneuvering at FL 390 to avoid cumulus buildups during a flight from Japan to Australia with 214 people aboard.

Shortly after the A330-200 entered an area of light precipitation, St. Elmo's fire appeared on the windshield, and "there was a brief period of disagreement between the aircraft's three sources of airspeed information," the ATSB report said. The autopilot and autothrottle disengaged, the flight control system reverted to alternate law, and several warning and cautionary messages were generated.

"The airspeed disagreement was due to a temporary [about five-second] obstruction of the captain's and [the] standby pitot probes, probably due to ice crystals," the report said, noting that the aircraft had experienced a similar incident eight months earlier. "Both of the events occurred in environmental conditions outside those specified in the certification requirements for the pitot probes."

St. Elmo's fire appeared on the windshield, and 'there was a brief period of disagreement between the aircraft's three sources of airspeed information.'

Faulty Coupling Leaks Fuel

Boeing 757-28A. No damage. No injuries.

The 757 was at FL 360, en route from Turkey to London Gatwick Airport with 226 passengers and eight crewmembers aboard the morning of June 12, 2010, when a "FUEL

CONFIG" warning appeared on the engine indicating and crew alerting system. The flight crew noticed a fuel imbalance, with 800 kg (1,764 lb) more fuel in the right wing tanks than in the left wing tanks.

While performing the quick reference handbook procedure for the fuel imbalance, the commander found a discrepancy of 800 kg between the fuel-consumed and the fuel-remaining indications. This discrepancy indicated a fuel leak because "fuel flow indications remained equal for both engines," said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The commander considered diverting the flight to Paris but decided to continue to London because the aircraft was nearing the beginning-of-descent point to Gatwick. "He made a PAN call [a declaration of an urgency] to London ATC [air traffic control], who cleared the aircraft for an immediate approach to Runway 26L with no speed or altitude constraints," the report said.

The crew shut down the left engine during the landing roll as a precaution against fire.

The crew shut down the left engine during the landing roll as a precaution against fire and parked and secured the aircraft on Runway 08L, where it was inspected by airfield fire and rescue services personnel. A substantial amount of fuel had spilled from the left wing, but there was no fire. The aircraft then was towed to a remote stand, where the passengers and crew disembarked normally.

A total of 3,800 kg (8,378 lb) of fuel remained in the aircraft's tanks. The commander estimated that 1,300 kg (2,866 lb) of fuel had leaked from the left wing.

A company maintenance engineer traced the leak to a sealing ring in a coupling between the left engine's high-pressure fuel pump and fuel governor overspill return tube. The sealing rings in both engines were replaced, and ground runs at maximum power revealed no further leakage.

"Further detailed investigation into the fuel leak was not possible, as the seals removed from the aircraft were discarded, rather than being retained as is required by the operator's engineering organization's procedures," the report said.

Gust Launches Jet Bridge

Embraer 135KL. Minor damage. No injuries.

The airplane was at a gate at Dubuque (Iowa, U.S.) Regional Airport, being prepared for takeoff with 44 passengers and three crewmembers the morning of April 3, 2011, when a strong gust pushed the jet bridge about 25 ft (8 m) into the Embraer's forward fuselage, creating a 20-in (51-cm) gash below the captain's side window.

"The airport had deactivated the brake system on the jet bridge during the winter months since the brakes would routinely freeze," the NTSB report said. "The gate agents who were operating the jet bridge attempted to keep it from being blown into the airplane, but, with the brake system deactivated, they were unable to do so."

A further complication was that the emergency stop button inside the jet bridge not only was ineffective in applying the brakes, it also isolated power to the control panel, rendering the steering system inoperative.

The report noted that the day before the incident, a technician had encountered problems while trying to reactivate the jet bridge's brake system. Repairs to complete the scheduled reactivation of the system had not been performed when the incident occurred.

Unstable Approach Leads to Overrun

Cessna Citation CJ2. Minor damage. No injuries.

Excessive airspeed throughout the descent, approach and landing was a factor in the CJ2's runway excursion at Kassel, Germany, the afternoon of March 24, 2010, said a report on the serious incident by the German Federal Bureau of Aircraft Accident Investigation.

The aircraft was inbound with a passenger and two pilots from Stuttgart. The second-in-command was flying from the left seat. Both pilots were familiar with Kassel-Calden Airport, having flown there several times. The weather at the airport was clear, and surface winds were from 160 degrees at 10 kt.

Nearing the airport from the southwest, the crew established the CJ2 on a left downwind leg to land on Runway 22, which was 1,500 m (4,921 ft) long and 30 m (98 ft) wide.

From recorded ATC radar data, investigators estimated that indicated airspeed had averaged 295 kt during the descent and 210 kt during the initial approach. On final approach, indicated airspeed was 190 kt.

"The crew subsequently reported that the aircraft crossed the Runway 22 threshold at about 130 kt, with the flaps set at the first position (15 degrees)," the report said, noting that the recommended procedure was to use a reference landing speed (V_{REF}) of 103 kt and full flaps (35 degrees). "Throughout, the speed was too high for a stable and well-controlled approach, even under visual flight conditions."

Neither pilot called for a go-around. The CJ2 touched down at about 120 kt and 572 m (1,877 ft) from the runway threshold, "from which point continual wheel/brake marks were left by both main landing gear," the report said.

Realizing that the aircraft could not be stopped on the runway, the crew intentionally steered it off the left side. This action "prevented a collision with the Runway 04 approach lights and possibly also the localizer antenna, which are all mounted on concrete plinths [pedestals]," the report said. "The decision to guide the aircraft toward open space avoided serious damage to the aircraft."

The CJ2 came to a stop, with the wheels and tires on the main landing gear sunk deeply in soft ground, 53 m (174 ft) from the runway edge.

Crewmember Falls From Door

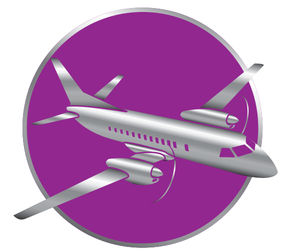
Boeing 717-200. No damage. One serious injury.

While preparing the 717 for departure from Ayers Rock, Northern Territory, Australia, the afternoon of March 4, 2010, a cabin crewmember had difficulty unlatching the open left forward door from the fuselage. Another cabin crewmember, who had shut the right forward door, came to help.

"The assisting cabin crewmember placed one foot outside the aircraft onto the portable stairs to assist with closing the door," the ATSB report said. "At this point, ground personnel commenced moving the portable stairs [away from the aircraft], and the assisting cabin crewmember fell through the open door onto the apron, [sustaining] a fractured left arm, a sprained right wrist and some other minor injuries."

The marshaler and the operator of the portable stairs had not been able to see the door from their positions. The report said that after the accident, the ground handling services provider adopted a requirement for one ground crewmember to remain at the top of the portable stairs and observe the door being closed and locked before signaling for the stairs to be removed.

TURBOPROPS



Turbine Blades Shed

Cessna 208 Caravan. Destroyed. No injuries.

The Caravan had been chartered to transport five employees of an industrial services company and a cargo of hazardous material — including blasting detonators, ammonium nitrate and nitromethane — the afternoon of Sept. 15, 2009. The airplane was climbing through 8,500 ft when a catastrophic engine failure occurred.

The pilot declared an emergency and prepared to land the 208 in a field near Sheffield, Massachusetts, U.S. The right wing struck a tree and separated on approach to the field, but the airplane came to a stop upright, the NTSB report said. The passengers and the pilot were able to exit the Caravan before it was engulfed in flames. The ammonium nitrate and nitromethane were consumed by the fire, but none of the detonators, which were stored in a metal box, ignited.

Investigators determined that the engine's first-stage sun gear splines had failed, causing the power turbine disk to overspeed and release turbine blades. The engine had accumulated 7,620 hours, including 65 hours since it was overhauled 19 months before the accident.

Maintenance records showed that "the sun gear found on the accident engine was previously removed from another engine due to 'spalled gear teeth' about seven years prior to the accident," the report said. "The condition of the sun gear when installed on the accident engine could not be determined."

Control Lost in Crosswind

CASA 212-200. Substantial damage. No injuries.

The flight crew was conducting a cargo flight the afternoon of Sept. 18, 2009, from Nome, Alaska, U.S., to Savoonga, which had surface winds from 010 degrees at 26 kt, gusting to 34 kt, 5 mi (8 km) visibility in light rain and an overcast at 800 ft.

The captain used full flaps for the approach to Runway 05, which was 4,400 ft (1,341 m) long and 100 ft (30 m) wide, and constructed of gravel. "The captain reported that during the landing roll, despite the use of differential power and other control adjustments, he could not maintain directional control," the NTSB report said. The CASA veered off the right side of the runway and struck a ditch.

The report noted that the maximum demonstrated crosswind component for the airplane is 20 kt. The operating manual recommends reducing the crosswind component by 25 to 75 percent for landing on a slippery runway and limiting flap extension to 15 degrees in a strong crosswind.

Oil Leaks Traced to Damaged Seals

Bombardier DHC-8-102. Minor damage. No injuries.

After a maintenance inspection at Exeter, England, the Dash 8, which was of Greek registry, was flown to East Midlands for repainting on April 16, 2010. The flight was uneventful; but, after the aircraft was parked, an engineer observed oil spots beneath both engine nacelles. The engineer tightened oil-system elbow joints on both engines and observed no leaks during a brief ground run following repainting.

During the positioning flight back to Exeter eight days later, a master warning was generated about 10 minutes after takeoff, and the crew noticed a loss of oil pressure in the right engine. "The copilot went into the cabin and observed what appeared to be a major oil leak coming from the right engine, with oil flowing down the right side of the aircraft fuselage," said the AAIB report.

'The copilot went into the cabin and observed what appeared to be a major oil leak coming from the right engine.'

The crew shut down the right engine, declared an urgency and requested ATC vectors directly to Exeter. Five minutes later, left-engine oil pressure began to fluctuate. "The copilot again entered the cabin and, this time, observed an oil leak from the left engine," the report said. "The commander made the decision to divert to the nearest suitable airfield and, with ATC assistance, diverted to Bristol, which was 25 nm [46 km] ahead of the aircraft." The Dash 8 was landed at Bristol International Airport without further incident.

"The oil leaks were traced to damaged O-ring seals within the oil cooler fittings on both engines," the report said. "Both oil coolers had been removed and refitted during the base maintenance check at Exeter. It was probably during reinstallation that the O-ring seals were damaged," in part by overtightening and misalignment of the fittings.

The technician who had reinstalled the oil coolers told investigators that he was under some time pressure to complete the job, which was difficult because of the small space in which the components are located. "He needed two hands to install each pipe and used a torch [flashlight], held in his mouth, to illuminate the pipe and oil cooler fitting," the report said.

When the maintenance inspection was completed, engine ground runs were performed per the aircraft maintenance manual to test systems and check for oil leaks, the report said. "However, a leak check of the oil cooler fittings was not specifically called for."

Parking Brake Set Improperly

Beech King Air E90. Substantial damage. No injuries.

After landing at Colorado Springs, Colorado, U.S., the night of Sept. 4, 2010, the pilot taxied the King Air to the ramp and was marshaled by ground personnel to a parking spot. He then set the parking brake and continued conducting a checklist with the engines running.

"Unbeknownst to the pilot, the airplane began to roll forward until it impacted a tug and ground power unit located approximately 25 ft [8 m] across the ramp," the NTSB report said. The nose landing gear collapsed, and the nose of the airplane came to rest atop the tug. The pilot shut down the engines, and he and his three passengers exited the King Air without assistance.

NTSB determined that the probable cause of the accident was "the pilot's failure to ensure that the airplane's parking brake was properly set before diverting his attention to other tasks."

PISTON AIRPLANES

Upside-Down in a Thunderstorm

Cessna 421C. Destroyed. Five fatalities.

The pilot was aware of convective activity on his route from McKinney, Texas, U.S., to Tampa, Florida, and planned to use the airplane's weather radar system and lightning detector, pilot reports and ATC assistance to avoid the thunderstorms during the July 8, 2009, afternoon flight.

The 421 was over the Gulf of Mexico when the pilot requested assistance from ATC to exit an area of turbulence. The Jacksonville Center controller told the pilot that if he continued straight ahead for about two minutes, he should be clear of the weather, according to the NTSB report.

A few seconds later, the pilot reported significant turbulence and downdrafts of 2,000 fpm. "He then requested a course reversal to exit the weather before he declared an emergency and advised ATC that the airplane was upside-down," the report said. "There were no further transmissions from the pilot, and radar contact with the airplane was lost."

Recorded ATC radar data showed that the 421 had entered rapidly developing cumulonimbus and an area of radar echoes indicating extreme precipitation intensities. Investigators concluded that the pilot lost control of the airplane, which subsequently broke up and descended into the gulf about 25 nm (46 km) northwest of Port Richey, Florida.

"The airplane's airborne weather radar may have been unable to provide an accurate representation of the radar echoes along the aircraft's flight path" due to attenuation, or the weakening and scattering of the transmitted radar energy by the intense precipitation, the report said. "Therefore, the final penetration of the intense portion of the storm was likely unintentional."

Engine-Out Simulation at V_{MC}

Beech 60 Duke. Destroyed. One fatality, one serious injury.

Shortly after takeoff from Edenton, North Carolina, U.S., for an instrument proficiency check the evening of June 7, 2010, the flight instructor retarded the left throttle to simulate an engine failure. The airplane was less than 100 ft above ground level, and indicated airspeed was at, or a few knots below, the Duke's minimum single-engine control speed (V_{MC}), according to the NTSB report.

"The pilot attempted to advance the throttles but was unable [to] since the flight instructor's hand was already on the throttles," the report said. "The airplane veered sharply to the left and rolled. The pilot was able to level the wings just prior to the airplane colliding with trees and terrain." The pilot sustained serious injuries, and the flight instructor was killed.

The pilot told investigators that before beginning the proficiency check, the flight instructor had not briefed him on procedures for simulating an engine failure and had mentioned that he had not flown a Duke "in a while."

On Auxiliary Tanks Too Long

Cessna 401. Substantial damage. Three serious injuries.

After a three-hour aerial mapping flight the afternoon of June 18, 2010, the 401 was on a 3-nm (6-km) final to land at Plymouth, Massachusetts, U.S., when both engines lost power.

While trying unsuccessfully to restart the engines, the pilot noticed that the fuel quantity indicators showed about 25 gal (95 L) remaining in the main tanks and 2–5 gal (8–19 L) remaining in the auxiliary tanks.

"The pilot then selected a forced-landing site between two large trees and landed the airplane in heavily wooded terrain," the NTSB report said.

Investigators determined that the pilot had not ensured that the fuel selectors were positioned to the main tanks, which is the first task on the "Before Landing" checklist. The 401's auxiliary tanks are designed for use only in cruise flight.

Fuel-Fed Fire Erupts on Departure

Piper Chieftain. Destroyed. One fatality, one minor injury.

Extensive maintenance, including the installation of four extra fuel tanks, had been performed to prepare the Chieftain to be ferried from the United States to Korea. Shortly after the airplane departed from Las Vegas for the first leg of the flight the afternoon of Aug. 28, 2008, a fire erupted in the right engine compartment.

The airplane, a Colemill Panther conversion, was about 7 nm (13 km) from North Las Vegas Airport when the pilot reversed course and declared an emergency. He feathered the right propeller but did not accelerate to best single-engine rate of climb speed or complete other actions required to configure the airplane for single-engine flight, said a report issued by NTSB in July 2011. As a result, the pilot was unable to arrest the descent rate.

The Chieftain struck trees and power lines, and came to a stop upside-down next to a house about 1.25 nm (2.3 km) from the runway. The pilot was killed, and one of the five people in the house received minor injuries.

The report said that the fire had originated in the vicinity of the engine-driven fuel pump and its fittings. Although extensive damage precluded a definitive conclusion about the cause of the fire, the report said that it likely had been fed by fuel leaking from either a supply line "B" nut, a broken fuel line or the fuel pump itself.

HELICOPTERS

Fuel Cross-Check Neglected

Bell 206B. Substantial damage. Two serious injuries.

The JetRanger was about 15 minutes into a 20-minute sightseeing flight along the coast near Coomera, Queensland, Australia, the afternoon of June 10, 2009, when the "FUEL PUMP" warning light illuminated, indicating low fuel pressure. "The pilot believed he had sufficient fuel on board and continued the flight," said the ATSB report.

The helicopter was descending to land at the Coomera helipad when the engine lost power due to fuel exhaustion. "During the final stages of the autorotative landing, the pilot was unable to arrest the helicopter's descent rate, and the helicopter struck the ground heavily," the report said. Two of the four passengers sustained serious injuries.

Examination of the JetRanger showed that the fuel gauge may have been over-reading. "The operator's practice when calculating the quantity of fuel to be added during refueling relied on the fuel gauge reading, without using an independent method to cross-check that reading against the actual fuel tank quantity," the report said.

Downdraft Causes Hard Landing

Aerospatiale AS 355F-1. Substantial damage. One serious injury, three minor injuries.

The pilot was maneuvering the helicopter to film an automobile participating in a hill climb at Pikes Peak, Colorado, U.S., on Sept. 17, 2010. A sharp turn in the racecourse near the top of the peak required the pilot to fly away from the mountain and then perform a 180-degree turn back toward the peak.

"After turning 180 degrees and on the inbound leg toward the mountain, the helicopter encountered a downdraft and was pushed toward rising terrain," the NTSB report said. "Helicopter performance at that altitude did not provide the pilot with a power margin great enough to arrest the descent."

The pilot attempted to land on a road, where the helicopter touched down hard and rolled over. The pilot sustained serious injuries.

Fatigue Cited in Rotor Blade Failure

Bell 206L-1. Destroyed. Three fatalities.

The emergency medical services crew was returning from a fund-raising event in Burney, Indiana, U.S., to their base in Rushville, Indiana, the afternoon of Aug. 31, 2008, when an 8-ft (2-m) section of a main rotor blade separated, rendering the LongRanger uncontrollable. The helicopter crashed in a corn field, killing the pilot, flight nurse and paramedic.

"Metallurgical examination determined that the blade failed as a result of fatigue cracking," the NTSB report said. "The origin of the fatigue crack coincided with a large void between the blade spar and an internal lead weight.

"Further investigation determined that the presence of residual stress in the spar from the manufacturing process, in combination with excessive voids between the spar and the lead weight, likely resulted in the fatigue failure of the blade."

Preliminary Reports, July 2011

Date	Location	Aircraft Type	Loss Type	Injuries
July 4	Pukatawagan, Manitoba, Canada	Cessna 208 Caravan	total	1 fatal, 8 minor/none
One passenger was killed when the Caravan overran the runway and went down an embankment during a rejected takeoff.				
July 4	Eidfjord, Norway	Eurocopter AS 350	total	5 fatal
The helicopter crashed and burned in mountainous terrain while transporting passengers to a remote area.				
July 5	Rackla, Yukon, Canada	Shorts SC-7 Skyvan	major	2 minor/none
The Skyvan touched down near the right side of the gravel runway, veered off and struck a ditch while landing on a cargo flight.				
July 6	Bagram, Afghanistan	Ilyushin 76	total	9 fatal
The cargo airplane struck a mountain about 25 km (13 nm) southwest of the airport during a night approach.				
July 8	Kisangani, Democratic Republic of Congo	Boeing 727	total	83 fatal, 35 minor/none
The 727 crashed about 300 m (984 ft) from the runway during an approach in heavy rain and low visibility.				
July 8	Chimaltenango, Guatemala	Bell 206	total	2 fatal, 1 serious
Witnesses said adverse weather conditions prevailed when the helicopter struck power lines and crashed on high terrain during a charter flight to Guatemala City.				
July 11	San Fernando, Mexico	Beech King Air 90	major	9 minor/none
The King Air was substantially damaged during a forced landing on open ground after both engines flamed out due to fuel exhaustion.				
July 11	Andaman Sea, Myanmar	Sikorsky S-76	total	3 fatal, 8 minor/none
The helicopter crashed in the sea after an apparent engine failure during departure from an oil platform.				
July 11	Strezhevoy, Russia	Antonov 24	total	6 fatal, 4 serious, 27 minor/none
The flight crew ditched the An-24 in the Ob River after an uncontained fire erupted in the left engine nacelle.				
July 13	Recife, Brazil	Let L-410 Turbolet	total	16 fatal
The airplane crashed near a beach shortly after the pilot reported an engine problem on takeoff.				
July 14	Warsaw, Poland	ATR 72	major	1 serious
The airplane was parked at a stand with the engines running in darkness and heavy rain when a baggage vehicle struck the right propeller. The vehicle driver was seriously injured, and propeller debris struck the ATR's wing and fuselage.				
July 21	Wadeye, Northern Territory, Australia	Eurocopter Super Puma	major	1 minor
The helicopter was being taxied on a ramp when the main rotor struck a light pole. Debris struck one person on the ground and a parked Swearingen Metro.				
July 23	Kei Mouth, South Africa	Cessna 208 Caravan	total	1 minor/none
The Caravan overran the runway during landing and traveled down a steep slope.				
July 26	Goulmima, Morocco	Lockheed C-130	total	80 fatal
The C-130 crashed on high ground about 10 km (5 nm) northeast of the airport during an approach in fog.				
July 28	Jeju Island, South Korea	Boeing 747	total	2 fatal
The airplane was on a cargo flight from Seoul to Shanghai, China, when the crew reported a fire and that they were diverting to Jeju. The crew subsequently reported control problems shortly before the 747 crashed in the East China Sea.				
July 29	Cairo, Egypt	Boeing 777	major	291 minor/none
The 777 was parked at a stand when a fire erupted on the flight deck. All 291 passengers were evacuated via jet bridges. The fire extensively damaged the cockpit and burned through the fuselage below the copilot's side window.				
July 29	Ife Odan, Nigeria	Eurocopter AS 350	total	3 fatal
The helicopter struck a hill in fog during a flight from Lagos to Ilorin.				
July 30	Georgetown, Guayana	Boeing 737NG	total	2 serious, 161 minor/none
The 737 overran the 7,448-ft (2,270-m) runway while landing in darkness and heavy rain, and traveled down a slope and through a fence before coming to a stop on the airport perimeter road.				

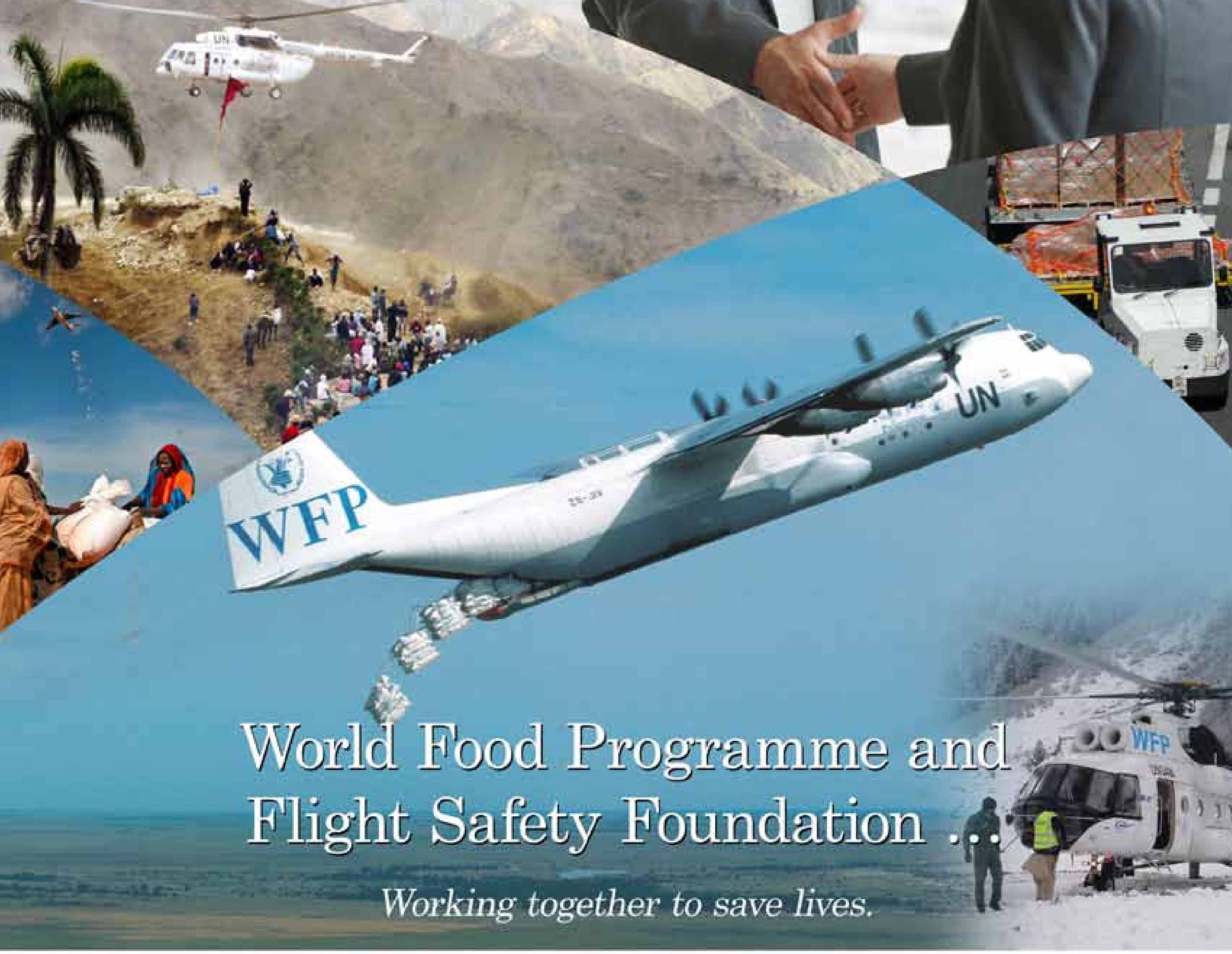
This information is subject to change as the investigations of the accidents and incidents are completed.

Source: Ascend

Selected Smoke, Fire and Fumes Events in the United States, June–July 2011

Date	Flight Phase	Airport	Classification	Subclassification	Aircraft	Operator
6/1/2011	Climb	Milwaukee (MKE)	Smoke	Unscheduled landing	Embraer ERJ-190	Not stated
The flight crew reported a strong odor in the cabin after takeoff, declared an emergency and returned to MKE. The aircraft was landed without incident. Maintenance troubleshot, performing high-power engine runs. They were unable to duplicate any odors. All functions were normal in an operational check.						
6/3/2011	Climb	Not stated	Smoke	Continued for landing	McDonnell Douglas MD-88	Delta Air Lines
The flight crew noticed that the left air conditioning pack indicator read 45 pounds per square inch (psi); the acceptable maximum was 28 psi. The crew turned off the air conditioning pack. The indicator then read 20 psi. The crew also noticed a faint, hot burning oil smell on climbout. Maintenance replaced the left air conditioning supply pressure transmitter. They were unable to duplicate the smell. The crew said that there was no smell during cruise or approach.						
6/4/2011	Climb	Not stated	Smoke/Fumes	Unscheduled landing	McDonnell Douglas MD-80	Delta Air Lines
A flight attendant reported a burning odor after takeoff. The right air conditioning pack was immediately secured and the smell dissipated. The flight crew found the right pack temperature valve at "full hot" and repositioned to it to the midrange. They reactivated the right pack and the odor returned. They secured the high-pressure bleed valve and the pack then operated normally. The auxiliary power unit (APU) inlets and the APU were found oil-soaked, but the leakage source was not identified. Maintenance ran the engines and APU in all configurations and did not produce any further odors. They performed a duct burnout according to the aircraft maintenance manual.						
6/5/2011	Climb	Harrisburg, Pennsylvania (MDT)	Smoke in cockpit	Emergency Diversion	Embraer ERJ-170	Not stated
The flight crew reported smoke in the cockpit during the climb. The crew declared an emergency, diverted to MDT and landed without incident. Maintenance troubleshot and found the first officer's lighting control panel at fault. Maintenance removed and replaced the lighting control panel.						
6/12/2011	Ground operations	Not stated	Smoke, fluid loss	Returned to gate	ATR 72	Executive Aircraft Charter
The crew reported that the no. 3 brake assembly was leaking fluid, as well as smoking due to foreign object debris hitting the brake line. The aircraft was removed from service. Maintenance replaced the no. 3 main brake assembly.						
6/16/2011	Cruise	Atlanta (ATL)	Smoke in cockpit and cabin	Continued with flight	Boeing 717	AirTran Airways
In level flight at 28,000 ft, flight attendants reported a burning odor in the vent. The first officer detected it as well. At the gate in ATL, the electric smell was very evident after the cockpit door was opened. Maintenance removed and replaced both coalescer bags.						
6/19/2011	Taxi/ground operations	Dallas/ Fort Worth (DFW)	Smoke, warning indication	Returned to gate	McDonnell Douglas MD-82	American Airlines
During taxi at DFW, the lavatory smoke alarm began to chime and there was a strong electrical odor in the vicinity of the aft left lavatory. No circuit breakers tripped and the odor disappeared. Maintenance replaced a malfunctioning overhead ballast and the aft left lavatory smoke detector.						
6/22/2011	Cruise	Not stated	Odor in cabin	Emergency landing	Boeing 737	Southwest Airlines
A strong odor was reported in mid-cabin during cruise flight. An emergency was declared and the flight was diverted. The recirculation and gasper fans were turned off. Maintenance removed and replaced the gasper fan.						
6/24/2011	Cruise	Los Angeles (LAX)	Smoke, warning indication	Unscheduled landing	Boeing 767	American Airlines
The crew reported a strong burning odor in the cockpit, accompanied by a status message: "FORWARD EQUIPMENT EXHAUST FAN." The equipment cooling switch was moved to standby and the odor seemed to dissipate. The utility buses were turned off as a precaution. The forward exhaust equipment cooling fan circuit breaker tripped. Maintenance replaced the forward rack exhaust fan.						
6/25/2011	Cruise	Not stated	Fumes in cabin and cockpit	Unscheduled landing	Boeing 767	American Airlines
The flight crew reported a strong odor of burning rubber in the cabin and cockpit. An emergency was declared and the flight was diverted. Landing was without incident. Maintenance replaced the seal and tightened a nut on the hot air supply tube.						
7/4/2011	Landing	Not stated	Smoke in cockpit	Continued landing	Boeing 737	US Airways
The crew reported smoke at the connector on first officer's sliding window during the landing roll. They turned off the window heating and the smoke stopped. Maintenance found a broken wire leading to the connector and re-pinned the connector.						
7/5/2011	Approach	Manchester, New Hampshire (MHT)	Odor/fumes in cabin	Continued flight	Embraer ERJ-190	US Airways
While en route to MHT, flight attendants and passengers reported an odor from the air conditioning packs that caused them to cough, beginning during the approach approximately 15 nm (28 km) from touchdown. The odor persisted until engine shutdown. Maintenance operated the engine bleed system with the packs operating and verified that the right pack bypass trim valve was bypassing hot air. They removed and replaced the pack bypass trim and the fault was corrected.						
7/13/2011	Cruise	Not stated	Electrical odor/ fumes in cabin	Continued flight	Boeing 777	American Airlines
The flight crew reported that a recirculation fan status message was displayed. An electrical smell was reported in the cabin simultaneously. The flight was landed without incident. Maintenance deferred work on the upper aft recirculation fan according to the minimum equipment list. The fan was later replaced.						

Source: Safety Operating Systems and Inflight Warning Systems



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WFP United Nations World Food Programme

For more information on how you can help, contact Susan Lausch in the FSF Development Department at development@flightsafety.org or phone +1.703.739.6700, ext. 112.

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