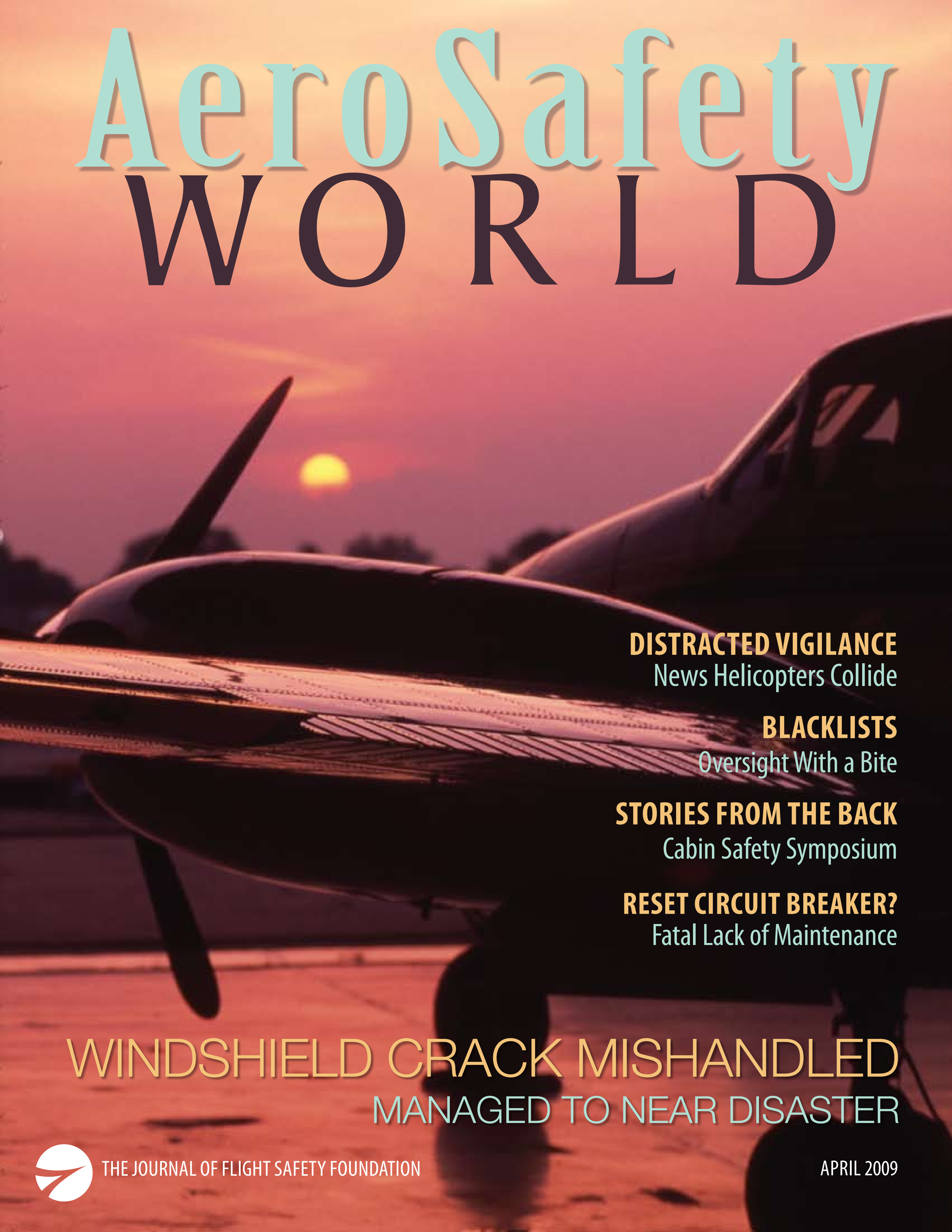

# AeroSafety WORLD

**DISTRACTED VIGILANCE**
News Helicopters Collide

**BLACKLISTS**
Oversight With a Bite

**STORIES FROM THE BACK**
Cabin Safety Symposium

**RESET CIRCUIT BREAKER?**
Fatal Lack of Maintenance

## WINDSHIELD CRACK MISHANDLED
MANAGED TO NEAR DISASTER

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

APRIL 2009

# SAFETY IN Bad Times

There are a couple of tough questions that keep coming up during every stop I make. One of the toughest is whether safety is going to suffer as a result of the economic downturn, and what we can we do about it. Here are some of the best answers I can come up with.

This year is not off to a good start. The trend lines for accident rates are flattening out, and may even be starting to rise. In addition, North America and Europe have suffered seven air carrier major accidents since August. It is too soon to assume we are entering a "dark age" for safety, but recent events cannot be ignored.

On a more positive note, I'll point out that we have empirical proof that economic stress does not have to result in a decline in safety. The period following the attacks of Sept. 11, 2001, despite most of the airlines in the United States filing for bankruptcy protection at least once, was the safest in U.S. commercial aviation history. Here is how I explain it:

First, I have to credit the extraordinary tenacity and professional integrity of the people on the line who ran the system every day while watching their dreams of prosperity and retirement slip away. Second, many carriers, especially the big ones, really caught on to the idea that predictive safety systems and protected reporting systems were good for the bottom line as well as good for safety.

Next, I have to point out that the regulators did some things that worked. This was the era when risk-based surveillance really took hold. The regulators had enough access to information about the operators to make informed decisions about who needed more attention and who needed less. The regulators didn't go soft; they just got smarter. When an operator failed to get the safety message, these gatekeepers were able to focus on the at-risk operators until they either got it right or went out of business.

Can we expect the same positive scenario around the world now that we have an even deeper recession? That depends on a lot of variables, so let me offer a short checklist to consider your risk:

- Do you have an experienced and dedicated workforce that can stay professional in spite of economic distractions?
- Does your airline really understand that proactive safety and reporting systems are essential to its business?
- Do you have a competent and capable regulatory authority that can intelligently target risks?
- Can your regulator act without fear of political interference and be able to present grounding as a credible threat?
- Is the relationship between the regulator and the industry open, effective and appropriate, or is it a game of hide and seek?

History tells us that a strong operator sometimes can stay safe without a strong regulator, but if your experience shows a weakness in both, we could be in for a rough year.

*William R. Voss*
*President and CEO*
*Flight Safety Foundation*

AeroSafetyWORLD

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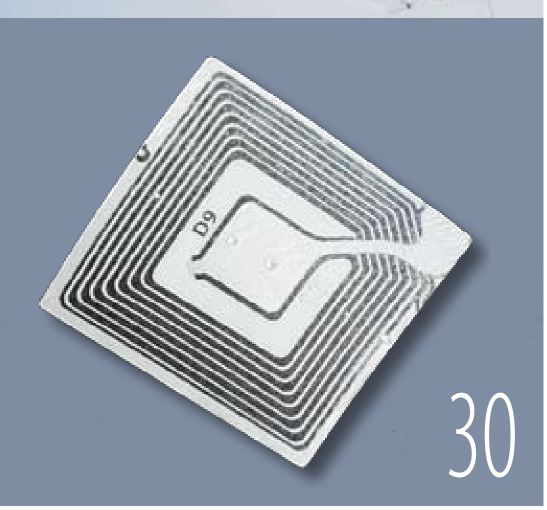


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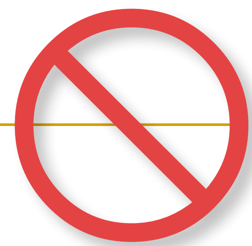



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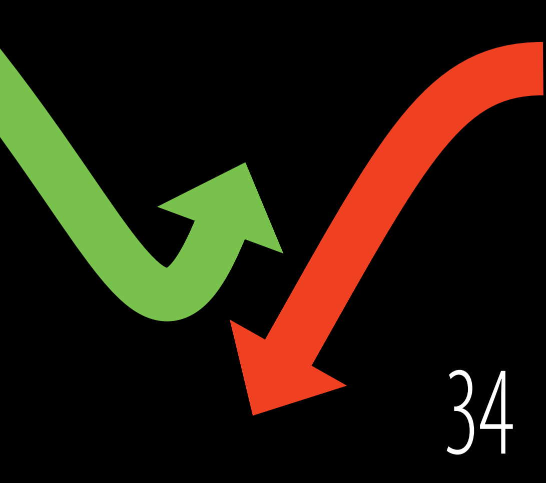


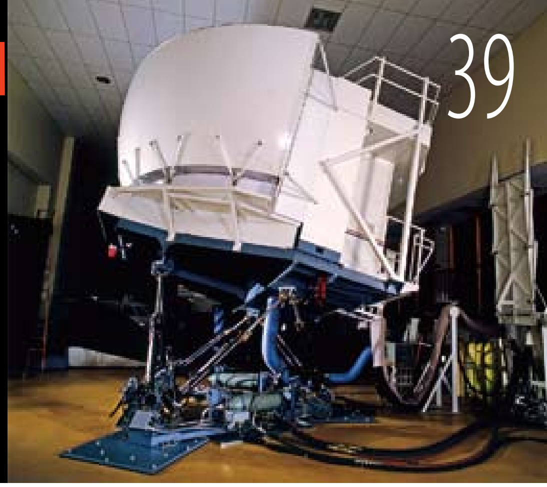





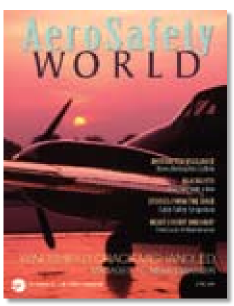


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Beech King Air suffered from
a cracked windshield poorly handled.
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue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

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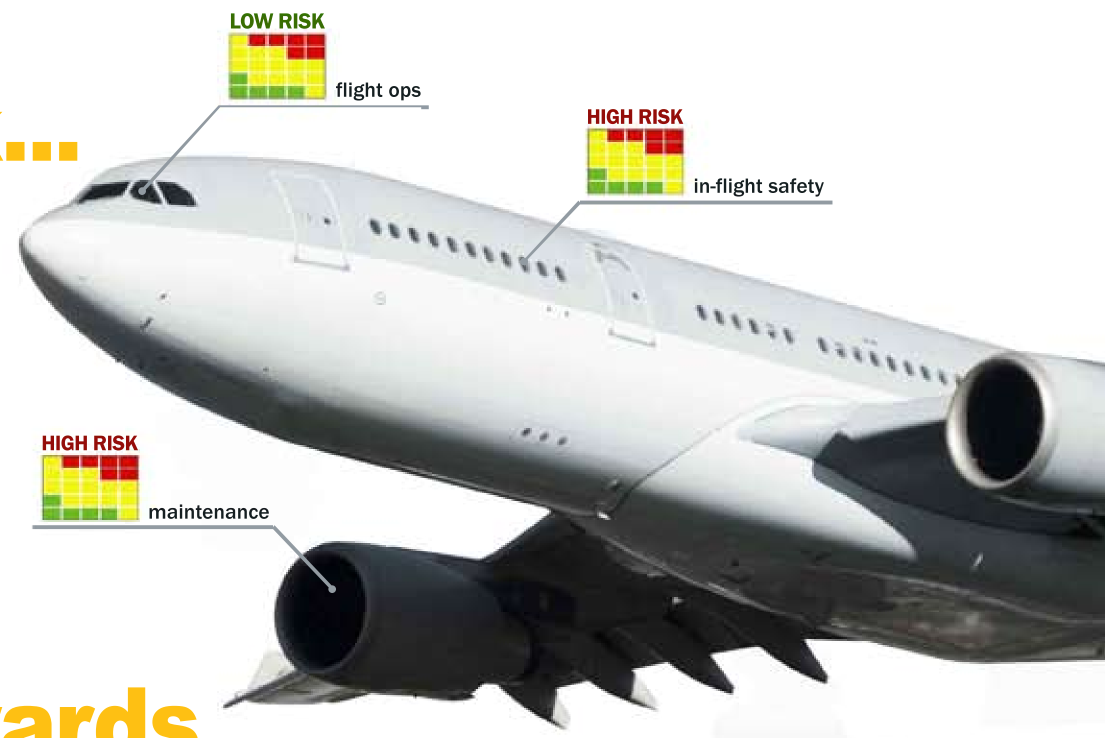
# Managing your air safety risk...

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# GREEN AND Safe

Environmental activists around the globe have aviation in their sights and the industry must respond. In many ways, the current uproar about aviation's contribution to global climate change mirrors past outbursts about aviation safety; some were justified, others were vastly overblown.

Everything connected to aviation, the highly visible and singular activity that it is, gets an exaggerated public response. We've found that being defensive about undeserved safety criticism doesn't get a lot of traction with a disturbed public. While presenting our case as best we can, in the end we must have a positive response to the public concern.

And so it goes with emissions: Protesting that aviation's contribution to the world problem is minimal won't win the day. Even less productive is trying to argue the existence of climate change. In the end we just have to suck it up and make a good-faith effort to improve, making certain that we blow whistles, wave our hands and issue press releases with every step taken toward being carbon neutral.

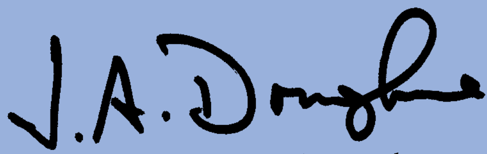
Meanwhile, we also have to be tempered in our rush to greenness. We cannot let our zeal to be Earth-friendly diminish our safety focus. This is not to point a finger at any aspect of the drive toward carbon neutrality; I've seen nothing that is an obvious risk. However, one only needs to look at the recent surprising developments with frozen ice crystals blocking the fuel flow on Rolls-Royce–powered Boeing 777s to get some idea of how complicated it will be to fully test and clear for use the alternative fuels now in development. When a jet fuel that has been in use for so many decades suddenly presents new, odious failure modes, it raises the question: How well do we need to test the new fuels?

Experts speaking at the recent Aviation and Environment Summit in Geneva predicted that sustainable biofuels could be ready for commercial aviation operations within five years. Where are these fuels coming from? Numerous sources are candidates. In addition to fuels from feed grains, there are fuels being tested made from plants including camelina, jatropha and halophytes, fuels from cellulosic material remain a possibility, and in the longer term fuel produced by algae may become available.

Efforts using feedstock to produce alcohol initially were welcomed until it was noted that these sources compete with human food, and their production requires a lot of carbon generation. Suddenly they came to be considered more of a hazard than a solution. The viability of the other candidates depends on how readily they can be produced and turned into fuel with minimal negative effects.

It may be that these new fuels are a direct swap for Jet A, but I doubt it. There are bound to be differences. In automotive fuels, the 15 percent ethanol content added in many areas of the United States reduces emissions without harming the engine, but the energy content of the mix is several percentage points lower than pure gas of the same octane rating. In an automobile, this is not an issue. However, every point counts in calculating aircraft performance.

I am not criticizing the biofuel effort. Fossil fuels are finite resources; renewable energy sources must be developed, even more so now to answer the call to stem the rate of climate change. But concern about the biofuel effort is an example of the care that must be exercised as we travel the road to a green aviation industry.



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

FLIGHT SAFETY FOUNDATION



# Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,170 individuals and member organizations in 142 countries.

## Member**Guide**

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**APRIL 14–15 ➤ Helicopter Safety and Operations Management Forum.** Aviation Week Management Forums. San Diego. Helen Kang, <helen_kang@aviationweek.com>, <www.aviationnow.com/forums/helimain.htm>, +1 212.904.6305.

**APRIL 20–21 ➤ Regional Air Safety Seminar: Air Accident Investigation in the European Environment.** European Society of Air Safety Investigators. Hamburg, Germany. Anne Evans, <aevans@aaib.gov.uk>, +44 1252 510300.

**APRIL 20–MAY 1 ➤ Advanced Accident Prevention and Investigation Course.** Southern California Safety Institute and Czech Republic Ministry of Transport. Prague. Sharon Morphew, <registrar@scsi-inc.com>, <www.scsi-inc.com/Prague%20Announcements.html>, 800.545.3766, ext. 104; +1 310.517.8844, ext. 104.

**APRIL 21–23 ➤ 54th annual Corporate Aviation Safety Seminar (CASS).** Orlando, Florida, U.S. Namratha Apparao, <apparao@flightsafety.org>, <www.flightsafety.org/seminars.html#cass>, +1 703.739.6700, ext. 101.

**APRIL 25–26 ➤ Regional Advanced Airport Safety and Operations Specialist School.** American Association of Airport Executives. Buffalo, New York, U.S. Stacey Renfroe, <stacy.renfroe@aaae.org>, <www.aaae.org/meetings/meetings_calendar/mtgdetails.cfm?MtgID=090416>, +1 703.824.0500.

**APRIL 26–28 ➤ 4th CANSO Asia Pacific ANSP Conference.** Civil Air Navigation Services Organisation. Singapore. Marc-Peter Pijper, <marcpeter.pijper@canso.org>, <www.canso.org/Canso/Web/events/asia+pacific>, +31 (0)23.568.5386.

**APRIL 27–MAY 1 ➤ Survival Factors in Aviation Accidents Course.** U.S. National Transportation Safety Board. Ashburn, Virginia, U.S. <trainingcenter@ntsb.gov>, <www.ntsb.gov/tc>, +1 571.223.3900.

**APRIL 27–28 ➤ Safety and Training Summit 2009.** *Rotor & Wing*. Denver. Randy Jones, <rjones@accessintel.com>, <www.safetyandtrainingsummit.com>.

**APRIL 28–30 ➤ World Aviation Training Conference and Tradeshow.** Halldale Media Group. Orlando, Florida, U.S. Fiona Greenyer, <fiona@halldale.com>, <www.halldale.com/WRATS.aspx>, +44 (0)1252 532000.

**APRIL 30 ➤ Annual Dinner/Meeting.** International Society of Air Safety Investigators, Mid-Atlantic Region. Herndon, Virginia, U.S. Ron Schleede, <ronschleede@cox.net>, +1 703.455.3766.

**MAY 3–7 ➤ Annual Scientific Meeting.** Aerospace Medical Association. Los Angeles. Dr. Russell B. Rayman, <rrayman@asma.org>, <www.asma.org/meeting/index.php>, +1 703.739.2240, ext. 103.

**MAY 4–6 ➤ 6th International Aircraft Rescue Fire Fighting Conference and Exhibits.** *Aviation Fire Journal*. Myrtle Beach, South Carolina, U.S. <avifirejnl@aol.com>, <www.aviationfirejournal.com/myrtlebeach/index.htm>, +1 914.962.5185.

**MAY 4–7 ➤ Aging Aircraft 2009.** Universal Technology Corp. Kansas City, Missouri, U.S. Jill Jennewine, <jjennewine@utcdayton.com>, <www.agingaircraft2009.com/index.html>, +1 937.426.2808.

**MAY 5–7 ➤ Technical Symposium.** Air Traffic Control Association, U.S. Federal Aviation Administration and U.S. National Aeronautics and Space Administration. Atlantic City, New Jersey, U.S. Claire Rusk, <claire.rusk@atca.org>, <www.atca.org>, +1 703.299.2430.

**MAY 6–7 ➤ Bird Strike Prevention Forum.** Aviation Week Management Forums. Chicago. Helen Kang, <helen_kang@aviationweek.com>, <www.aviationnow.com/forums/birdmain.htm>, +1 212.904.6305.

**MAY 11–12 ➤ Risk Management Course.** ScandiAvia. Stockholm. Morten Kjellesvig, <morten@scandiavia.net>, <www.scandiavia.net/index.php/web/artikkel_kurs/risk_management_course/>, +47 91.18.41.82.

**MAY 12–14 ➤ EBACE2009.** European Business Aviation Association and National Business Aviation Association. Geneva. <info-eu@ebace.aero>, <info-us@ebace.aero>, <www.ebace.aero/2009>, +32 2.766.0073, +1 202.783.9000.

**MAY 12–14 ➤ Safety Manager Course.** Aviation Research Group/U.S. Denver. Kendra Christin, <kchristin@aviationresearch.com>, <www.aviationresearch.com/press_detail.asp?id=46>, +1 513.852.5110, ext. 10.

**MAY 21–22 ➤ Waypoint AirMed and Rescue.** Waypoint. Oxford, England. <info@airmedandrescue.com>, <www.airmedandrescue.com>, +44 (0)117 922 66 00, ext. 2.

**JUNE 2–4 ➤ 2009 Europe/U.S. International Aviation Safety Conference.** European Aviation Safety Agency and Hellenic Civil Aviation Authority. Athens, Greece. Ross Inwood, <athens2009@easa.europa.eu>, <www.easa.europa.eu/conf2009>, +49 221 89990 2041.

**JUNE 3–4 ➤ Flight Simulation Conference: Towards the Edge of the Envelope.** Royal Aeronautical Society. London. <conference@aerosociety.com>,<www.aerosociety.com/conference/indexconf.html>, +44 (0)20 7670 4345.

**JUNE 9–11 ➤ Aviation Ground Safety Seminar.** National Safety Council, International Air Transport Section. Bournemouth, England. B.J. LoMastro, <B.J.LoMastro@nsc.org>, <www.nsc.org>, +1 630.775.2174.

**JUNE 10–11 ➤ CAE Flightscape Users Conference.** CAE Flightscape. Ottawa. <info@flightscape.com>, <www.flightscape.com/about/conferences.php>, +1 613.225.0070.

**JUNE 15–21 ➤ International Paris Air Show.** Gifas (Groupement des Industries Françaises Aéronautiques et Spatiales). Paris Le Bourget. <siae@salon-du-bourget.fr>, <www.paris-air-show.com>, +33 (0)826 465 265.

**JUNE 15–18 ➤ Human Factors Initial and Train-the-Trainer Courses.** The Aviation Consulting Group. Phoenix. Bob Baron, <tacg@scccoast.net>, <www.tacgworldwide.com/humanfactorstraining.htm>, 800.294.0872, +1 954.803.5807.

**JUNE 25–27 ➤ 14th Annual Flight Attendants Conference.** National Business Aviation Association. New Orleans. Jay Evans, <jevans@nbaa.org>, <web.nbaa.org/events/fac/2009>, +1 202.783.9353.

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If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early — we'll keep it on the calendar through the issue dated the month of the event. Send listings to Rick Darby at Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or <darby@flightsafety.org>.

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

# Safety News

## Component Redesign Sought

A component on Boeing 777 Rolls-Royce RB211 Trent 800 series engines should be redesigned to eliminate the possibility of an icing buildup similar to those that have been cited in two engine thrust rollbacks in 2008, the U.S. National Transportation Safety Board (NTSB) says.

In safety recommendations to the U.S. Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA), the NTSB also said that after the redesign of the fuel/oil heat exchanger (FOHE) is complete, operators should be required to install the new system on affected 777s at the next maintenance check or within six months.

Rolls-Royce has indicated that redesign already has begun and that the system should be ready for installation within 12 months, the NTSB said.

In issuing its recommendations, the NTSB cited the Jan. 17, 2008, crash of a British Airways 777-200ER just short of the landing runway at London Heathrow Airport after a flight from Beijing. One person was seriously injured and 12 received minor injuries in the crash, and the airplane was substantially damaged. The U.K. Air Accidents Investigation Branch (AAIB) said in preliminary reports that an accumulation of ice on the FOHE restricted the flow of fuel to the engines, resulting in a dual-engine thrust rollback.

The NTSB also cited a Nov. 26, 2008, incident involving a single-engine thrust rollback in a Delta Air Lines 777 during the cruise segment of a flight from Shanghai, China, to Atlanta. The flight crew performed Boeing's published procedure to recover engine performance and resumed normal flight.

Since the incidents, Boeing has developed additional procedures for dealing with the problem, and the FAA and EASA have incorporated those procedures into airworthiness directives.

"While the procedures may reduce the risk of a rollback in one or both engines due to FOHE ice blockage, they add complexity to flight crew operations, and the level of risk reduction is not well established," the NTSB said. "And because


U.S. National Transportation Safety Board

the recovery procedure requires a descent, the aircraft may be exposed to other risks such as rising terrain or hazardous weather, or the inability to achieve maximum thrust during a critical phase of flight, such as during a missed approach."

As a result, the NTSB said a redesign of the FOHE was "the only acceptable solution" to the safety risk.

Because two similar events occurred within one year, without corrective action, NTSB Acting Chairman Mark V. Rosenker said, "We believe that there is a high probability of something similar happening again."

## Overheated Temperature Probe

The Spanish aviation accident investigation body has recommended that Boeing be required to include in various information manuals instructions on dealing with overheating of the ram air temperature probe while an airplane is on the ground.

The Comisión de Investigación de Accidentes e Incidentes de Aviación Civil cited the Aug. 20, 2008, crash of a McDonnell Douglas MD-82 after takeoff from Madrid-Barajas Airport. The crash killed 154 people, 18 were seriously injured, and the airplane was destroyed.

© Javier Pedreira/flickr

Before takeoff, the crew had returned to the gate so the overheated temperature probe could be examined by maintenance personnel, who disabled the circuit breaker that supplied power to the probe. A preliminary investigation found that the airplane's flaps and slats were not in takeoff configuration, "resulting in the failure of the airplane to climb properly," and that the crew did not receive an automated takeoff configuration warning during the takeoff roll, the commission said.

The commission said that the steps that should be taken to find the cause of high ram air temperature indications on the ground are not specifically cited in the manufacturer's maintenance manuals, and that airworthiness instructions do not address two possible problems involving temperature probe heating: improper heating on the ground and no heat while airborne.

The commission recommended that the European Aviation Safety Agency and the U.S. Federal Aviation Administration require Boeing to add relevant information to the aircraft maintenance manual, troubleshooting manual and fault isolation manual.

## NVG Alert

Certain light emitting diode (LED) lighting systems are not visible through night vision goggles (NVG), and NVG users should exercise caution when flying near areas where these lighting systems may be operating, the U.S. Federal Aviation Administration (FAA) says.


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The FAA cited a report issued in 2008 by the Canadian Air Force Directorate of Flight Safety, which identified the problem, which involves some obstruction lighting systems that use red LEDs. The lights are visible to the naked eye but not through NVGs.

"Aviation Red light ranges from about 610 to 700 nanometers (nm), and NVGs approved for civil aviation … are only sensitive to energy ranging from 665 to about 930 nm," the FAA said in *Safety Alert for Operators*, No. 09007. "Because LEDs have a relatively narrow emission band and do not emit infrared energy like incandescent lights, it is possible for them to meet FAA requirements for Aviation Red but be below the range in which NVGs are sensitive."

## Zero Fuel Weight Changes

The U.S. Federal Aviation Administration (FAA) has issued a policy change to prevent operators from claiming that the applicable operating rules for their aircraft have been changed by obtaining supplemental type certificates (STCs) that reduce the aircraft's maximum zero fuel weight (MZFW).

The FAA said it is "aware that persons have obtained STC or amended TC [type certificate] approvals to change an aircraft's FAA-approved limitation and then use the approvals to change the applicability of operating rules they operate under. The STC (or amended TC) may or may not actually make a change to the aircraft."

Because the changes are not changes in type design, the original TC still determines whether the aircraft is operated under U.S. Federal Aviation Regulations Part 125 or less stringent regulations, the FAA said.

## Investigative Cooperation

The Italian flight safety board, the Agenzia Nazionale per la Sicurezza del Volo (ANSV), says it has established a new "effective spirit of cooperation" with the Italian Ministry of Justice for the investigation of aviation accidents.

"In particular, the Ministry of Justice invited the directors of public prosecutions with the appeals courts to stipulate that, in the case of an accident involving an aircraft and immediately following the event, in compatibility with search and rescue activities, there shall be no tampering with or alteration of evidence before the arrival of the assigned ANSV investigators," the ANSV said.

According to the agreement, the recovery of wreckage also should be coordinated with the ANSV.

The ANSV statement followed criticism by aviation safety organizations, including Flight Safety Foundation, of prosecutors in Italy and France for their interference in accident investigations in both countries.

The investigations involved the Nov. 27, 2008, crash of an Air New Zealand Airbus A320 off the coast of France and the Feb. 7, 2009, crash of a Cessna Citation in Rome. Seven people were killed when the A320, on a post-maintenance test flight, plunged into the Mediterranean Sea during an approach to Perpignan Airport. Two pilots — the only people in the Citation — were killed after encountering a thunderstorm after departure from Rome to pick up personnel for an emergency medical services flight.

Flight Safety Foundation said in late February that investigations of both accidents had been delayed "because law enforcement authorities seized vital evidence before safety investigators could examine it." Some of the evidence was subsequently returned to investigators.

"Unless there is evidence of sabotage, law enforcement and judicial authorities need to step aside, allow accident investigators immediate access to the wreckage and to surviving crew and passengers, and let safety professionals do their job," said Foundation President and CEO William R. Voss. "To prevent another tragedy, it's far more important that we learn what happened and why than to build a criminal case."

© Andrei Dimofte/Wikimedia

## Multimillion-Dollar Penalty

Southwest Airlines will pay a $7.5 million civil penalty to resolve U.S. Federal Aviation Administration (FAA) enforcement actions for operating 46 airplanes on 59,791 flights without performing required inspections for fatigue cracking in the fuselage, the FAA says.

The penalty could double if Southwest does not perform 13 safety improvements outlined in an agreement with the FAA. Those improvements include increasing the number of on-site technical representatives for heavy maintenance vendors, granting FAA inspectors improved access to information used to track maintenance activities, rewriting FAA-approved manuals and designating a quality assurance manager who does not have responsibility for air carrier certification.

The penalty stemmed from what the FAA said was Southwest's failure, during parts of 2006 and 2007, to comply with a 2004 airworthiness directive that required repetitive inspections of some fuselage areas to detect fatigue cracks. When the penalty was first proposed, Southwest said that the missed inspections were "one of many routine and redundant inspections" involving "an extremely small area in one of the many overlapping inspections" aimed at early detections of fatigue cracking.


© Brian Futterman/Wikimedia

"This agreement furthers aviation safety by requiring important improvements to the airline's safety program," FAA Acting Administrator Lynne A. Osmus said. "Some of those safety measures exceed FAA regulations."

© Kyodo/Associated Press

*Japanese accident investigators inspect the wreckage of a FedEx McDonnell Douglas MD-11 cargo plane that crashed on landing at Narita International Airport east of Tokyo on March 23. The two pilots — the only people in the airplane — were killed.*

## In Other News …

ARINC has launched an air-ground data link communications service in **Brazil** that covers all major South American air routes. GLOBALink/VHF ACARS is being carried over the Brazilian Department of Airspace Control's air and ground facilities. … **Airservices Australia** plans to upgrade three of its air traffic control towers with technology provided jointly by Nav Canada and Sensis Corp. The upgrade is intended to provide controllers with immediate access to flight data and voice communications, and to monitor the airports and their surrounding airspace, Nav Canada said.

**Correction …** The source was cited incorrectly for Table 1 on p. 35 of the February issue of *ASW*. The correct source is: Lambregts, A.A.; Nesemeier, G.; Wilborn, J.E.; Newman, R.L. "Airplane Upsets: Old Problem, New Issues." Paper presented at American Institute of Aeronautics and Astronautics Modeling and Simulation Technologies Conference and Exhibit, Aug. 18–21, 2008. AIAA 2008-6867.

*Compiled and edited by Linda Werfelman.*

# DISTRACTED

**The pilots of two TV news helicopters were busy with news-reporting duties in the seconds before their midair collision in Phoenix.**

BY LINDA WERFELMAN

Five television news-gathering helicopters were maneuvering to cover a police chase in Phoenix on July 27, 2007, when two of the aircraft — both Eurocopter AS 350B2s — collided over a downtown park as their pilot-reporters were describing the events occurring on the ground. The crash killed the two pilot-reporters and two news photographers and destroyed both helicopters.

The U.S. National Transportation Safety Board (NTSB), in its final report on the accident, said that the probable cause was the failure of both pilots to see and avoid the other helicopter, and "contributing to this failure was the pilots' responsibility to perform reporting and visual tracking duties to support their station's ENG [electronic news gathering] operation."

The report identified as a contributing factor "the lack of formal procedures for Phoenix-area ENG pilots to follow

Ross D. Franklin/Associated Press

regarding the conduct of these operations."

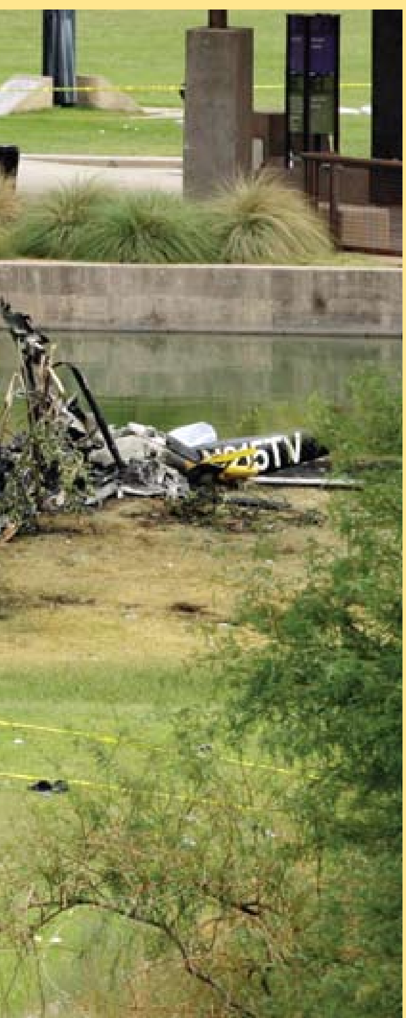
Visual meteorological conditions prevailed when the midair collision occurred at 1246 local time, about 23 minutes after a police helicopter contacted air traffic control (ATC) to join the pursuit by police on the ground of a suspect accused of stealing a pickup truck, backing it into a police vehicle and then fleeing in the truck. Over the next 22 minutes, pilots of the five news helicopters also checked in with ATC and headed for the area of the police chase.

**Helicopter Position Information**


**Notes**: Altitude was not available for position reports immediately before the collision. Yellow line indicates path of truck.

Source: U.S. National Transporation Safety Board; Aerial photograph, Google Earth

**Figure 1**



**An accident investigator photographs the wreckage of one of two TV news helicopters that crashed to the ground in a downtown Phoenix park after a midair collision. Four people were killed in the 2007 crash.**

In accordance with informal procedures, the six helicopter pilots shared an air-to-air radio frequency to report their positions and their intentions. The accident helicopters — from Channel 3 and Channel 15 — had audio-video recording systems, and the information recorded by those systems was analyzed in the accident investigation. At 1238, the Channel 15 pilot was recorded telling the other pilots that he was flying at 2,200 ft, and the Channel 3 pilot said that his helicopter was at 2,000 ft (Figure 1).

"According to the Channel 3 and 15 audio recordings, about 1241:02, the Channel 15 pilot stated, 'I'll just kinda park it right here.' About 1241:18, the Channel 3 pilot broadcast, "OK, I'm gonna move.' Between about 1241:22 and about 1241:26, the Channel 15 pilot stated, 'where's three?' … 'like how far?' … and 'oh jeez.' The Channel 15 pilot then transmitted, 'Three. I'm right over you. Fifteen's on top of you.' Afterward, the Channel 3 pilot questioned which helicopter Channel 15 was over, to which the Channel 15 pilot responded, 'I'm over the top of you.' About 1241:34, the Channel 3 pilot indicated that he was operating at 2,000 feet. About 1242:25, the Channel 3 pilot stated to the Channel 15 pilot, 'OK. … I got you in sight,' to which the Channel 15 pilot responded, about three seconds later, 'got you as well.'"

These comments — about four minutes before the collision — were the last in which the two pilots coordinated their helicopters' positions or intentions. The video recordings from the helicopters showed that, during those four minutes, both helicopters continued to change position.

The report said that the suspect stopped the stolen vehicle about 1246:05, and in a broadcast recording that began at 1245:43, the Channel 3 pilot said, "Looks like he [the suspect] is starting to run. … Looks like he's gonna try and take another vehicle … looks like they've got him blocked in there, but he did get … " The Channel 3 report then ended "suddenly, with an unintelligible word," the NTSB said.


Pat Shannahan/Associated Press

Pilots of the two TV news helicopters had traded information about the positions of their aircraft several times, but investigators say the last exchange came about four minutes before their midair collision.

The Channel 15 pilot, in a live broadcast that began at 1246:03, said, "He [the suspect] has stopped … now it's a foot chase. Now he's in another vehicle … doors open police … oh jee." That report also ended suddenly, the NTSB said, and audio recordings from both helicopters indicated that the midair collision occurred about 1246:18.

Both helicopters plunged to the ground in a city park, and the pilot of a third ENG helicopter told ATC there had been a midair collision.

The Channel 3 pilot, who in September 2006 reported having 13,579 flight hours, received a commercial pilot certificate with a rotorcraft-helicopter rating on Aug. 24, 1987. He also held a certified flight instructor certificate with a rotorcraft-helicopter rating and a second-class medical certificate. He was a backup pilot under contract to Channel 3 and a part-time employee; the station's chief pilot said that the accident pilot had flown 79 flights and 124 flight hours for the station between Jan. 2 and July 5, 2007. The accident pilot also worked full time for Westcor Aviation in Scottsdale, Arizona, as director of operations and a charter pilot; the operator said the accident pilot had flown 88 hours for the company in 2007.

The Channel 15 pilot, who had 8,006 flight hours — all in helicopters, including 907 hours in AS 350B2s — received a commercial pilot certificate with a rotorcraft-helicopter rating on Dec. 7, 1990. He held a second-class medical certificate with a waiver for defective color vision; the NTSB report said that the deficiency was not a factor in the accident. The pilot was hired in October 2005 by U.S. Helicopters, which had a contract to provide helicopter service to Channel 15. He flew an average of 45 hours per month for the station and did no other flying for U.S. Helicopters, the report said.

The Channel 3 helicopter had an ENG monitor near the instrument panel that displayed four scenes simultaneously: the station's current broadcast, the video being recorded by the helicopter's photographer and two other scenes selected by the pilot-reporter. The Channel 15 helicopter had a similar monitor that displayed one scene at a time.

The Channel 3 helicopter was equipped with an L-3 Communications SkyWatch SKY497 traffic advisory system that provided aural traffic warnings via the pilot's headset, displayed traffic on a Garmin GNS 430 navigation unit and provided 20- to 30-second warnings of aircraft that were on a collision path.

"The system issued an aural alert when aircraft entered a cylinder of airspace surrounding the pilot's aircraft that had a horizontal radius of … 1,216 ft [371 m] and a height of plus or minus 600 ft [183 m]," the report said. Manufacturer's guidance said that after hearing an alert, the pilot should look for the traffic and comply with right-of-way procedures. The guidance material also noted that an alert is generated only when the collision threat is first detected and that it is possible for the alert to be "inhibited."

Channel 3's chief pilot told investigators that the system had been functioning when he flew the helicopter earlier on the day of the accident. He also said that, in situations in which "a lot of traffic (was) in close," the volume of the aural alert was turned down to ensure that the pilot could hear radio transmissions on the communications frequency.

Channel 15's helicopter had no on-board traffic advisory system, the report said.

In addition to their use of the shared air-to-air frequency and their scans of the TV display screens in the cockpit, the pilot-reporters monitored the Phoenix air traffic control tower frequency on another radio, communicated with their station news departments on a third radio and talked with their photographers over an intercom, the report said.

## 'Adequate' Communication

Radar data showed that the Channel 15 helicopter had been between 2,000 and 2,200 ft and entered a climbing right turn in the seconds before the crash; the last radar return showed the helicopter at 2,300 ft. At the same time, the Channel 3 helicopter, which had been at 2,000 ft, turned right; the last radar return showed the helicopter at 2,100 ft.

As part of the investigation, NTSB representatives met with Phoenix ENG helicopter pilots, who said that communication between the accident pilots had been "adequate" during the police chase. They also noted that, at the time of the accident, all operators except one used pilot-reporters to fly their aircraft; the exception was a station that employed a reporter-photographer.

However, the pilots told investigators that they sometimes lost sight of other helicopters because the aircraft paint schemes "tended to blend in with the desert landscape and vegetation." They recommended the use of high-visibility paint schemes for main rotors and tail rotors, and light-emitting diode (LED) anti-collision lights to improve helicopter conspicuity. Neither accident helicopter had these features.

The chief pilot for Channel 3 told investigators that, since the accident, pilots of the ENG helicopters have had "a lot more" air-to-air communication, describing the location of their helicopters and acknowledging the positions of others.

"He also stated that, in a static situation, such as a building fire, no helicopters would change position until all of the pilots responded and that, in a dynamic situation, such as a car chase, the pilots would constantly communicate with one another and confirm each other's positions," the report said. "He further indicated that the pilots were providing more distance between each other's helicopters and were asking the photographers more often to check clearances (separation) with other helicopters."

The two accident pilots were experienced in helicopter operations in general and ENG operations in AS 350B2s in the Phoenix area in particular, the report said. Both also were experienced in simultaneously flying their helicopters and reporting.

"Many of the tasks that the pilots were performing during the accident flight — such as flying the helicopter, operating the radios and initiating communications — were well-learned skills that would have been performed without much cognitive or physical

### Eurocopter AS 350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The Eurocopter AS 350 is a light five/six-seat utility helicopter first produced in October 1977 by Aerospatiale as the AS 350B. The Aerospatiale helicopter division and the MBB (Messerschmitt-Bolkow-Blohm) helicopter division merged to form Eurocopter in 1992.

Several versions have been produced since the first AS 350Bs, which were powered by a 478 kw (641 shp) Turbomeca Arriel 1B turboshaft engine and a main rotor system comprising three fiberglass blades. The next version was the AS 350BA, with larger main rotor blades and an increased takeoff weight.

Current versions include the AS 350B2, certified in 1989, and the AS 350B3, first certified in France in 1997. The AS 350B2 has a 546 kw (732 shp) Arriel 1D1 engine, a maximum cruise speed of 134 kt at sea level and a maximum takeoff weight of 2,250 kg (4,960 lb) or 2,500 kg (5,512 lb) with an external load. The AS 350B3 has a 632 kw (847 shp) Arriel 2B engine, maximum cruise speed of 140 kt at sea level and a maximum takeoff weight of 2,250 kg, or 2,800 kg (6,173 lb) with an external load.

Source: *Jane's All the World's Aircraft* effort," the report said. "However the two helicopters collided without either pilot detecting the impending hazard. Thus, even for experienced pilots, the ability to shift attention among competing task demands may break down under high workload conditions and can lead to a narrowing of attention on a specific task."

A review of audio recordings showed that the accident pilots did not use the air-to-air frequency to report their positions as often as the ENG pilots participating in the post-accident interview had thought, the report said.

"It is difficult to determine the extent that the Channel 3 and [Channel] 15 pilots' reporting duties contributed to the breakdown in each pilot's awareness of the other helicopter," the report said. "The additional tasks of directly observing activities on the ground and providing narration could have affected the pilots' ability to maintain their helicopter's position or track the other helicopter's positions. From about 1245:43 (Channel 3) and about 1246:03 (Channel 15) to the time of the collision, the pilots were continuously reporting the events as they unfolded, which narrowed the pilots' attention to the ground and away from other tasks, such as maintaining the helicopters' stated position and altitude and scanning the area for potential collision hazards.

"Even with the limited evidence to determine the extent that the pilots' ENG-related duties affected their ability to see and avoid the other helicopter, the circumstances of this accident demonstrated that a failure to see and avoid occurred about the time that a critical event of interest to the ENG operations (the carjacking) was taking place on the ground. … It is critical for ENG pilots to be vigilant of other aircraft during close-in operations and not to divert their attention to a non-flying-related task or event."

The NTSB also cited a report filed with the U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) — one of 18 reports of near-midair collisions involving ENG helicopters — in which the pilot described how he inadvertently allowed his helicopter to descend toward a police helicopter because his "hectic" workload had distracted him from altitude awareness.

"The midair collision in [Phoenix] and the near-midair collisions described in … ASRS reports demonstrate the hazards involved in conducting ENG operations with multiple aircraft nearby," the report said. "The safety board concludes that the Channel 3 and 15 pilots' reporting and visual tracking duties immediately before the collision likely precluded them from recognizing the proximity of their helicopters at that time."

## Aftermath

After the accident, both Channel 3 and Channel 15 modified their flight operations. The Channel 3 news helicopter is now staffed by two pilots — one to handle flying and the second to handle news reporting. The Channel 15 helicopter pilot no longer has reporting duties; the helicopter carries a photographer to obtain video.

In February, the Helicopter Association International (HAI) approved a new *Broadcast Aviation Safety Manual* developed along the lines of many of the NTSB safety recommendations issued as a result of the accident investigation.

The 10 safety recommendations included a call for the U.S. Federal Aviation Administration (FAA) to require ENG operators to assign reporting duties to "someone other than the flying pilot, unless it can be determined that the pilot's workload would remain manageable under all conditions," and to require high-visibility blade paint schemes and high-visibility anti-collision lights on ENG aircraft.

Other recommendations said the FAA should develop standards for helicopter cockpit electronic traffic advisory systems to notify pilots of the presence of nearby aircraft, and require that the systems be installed in ENG aircraft; host annual ENG helicopter conferences to discuss relevant issues, and, based on those discussions, develop agreements specifying minimum horizontal and vertical aircraft separation requirements; and incorporate information from the HAI safety manual into an FAA advisory circular.

Other recommendations — superseding similar recommendations issued in 2003 — call for requiring the installation of a "crash-protected flight recorder system" on new and existing turbine-powered, non-experimental, non-restricted-category aircraft that are not equipped with a flight data recorder and cockpit voice recorder and that are operated under U.S. Federal Aviation Regulations Parts 91, 121 or 135. The recorder should record cockpit audio, if a cockpit voice recorder has not already been installed, as well as "a view of the cockpit environment to include as much of the outside view as possible" and flight data, the NTSB said.

Since 2004, the NTSB has included similar recommendations on its "most wanted" list of transportation safety improvements.

*This article is based on U.S. National Transportation Safety Board (NTSB) Accident Report NTSB/AAR-09/02, "Midair Collision of Electronic News Gathering Helicopter KTVK-TV, Eurocopter AS350B2, N613TV, and U.S. Helicopters Inc., Eurocopter AS350B2, N215TV, Phoenix, Arizona, July 27, 2007." Jan. 28, 2009.*


BY J.A. DONOGHUE

# Beyond Compliance

**Seminar speakers stress the need to exceed basic requirements.**

"Aviation safety is not that good so far this year," said William R. Voss, president and chief executive officer of Flight Safety Foundation, opening the 21st European Aviation Safety Seminar in Nicosia, Cyprus. We need to work harder to improve safety, Voss said, to fulfill "our promise to the public that we are not waiting for the next accident."

A successful safety system depends on "a competent and effective regulator" operating free of political interference that establishes a close relationship with its operators. Further, experience has shown that networks of airlines providing oversight functions for each other, and regulators auditing each other around the world, produce an interconnected process that can continue to protect safety should a regulator or an airline begin to fail, Voss said.

Inter-airline safety oversight, airlines working together, also was suggested by Tomislav Gradisar of Croatian Airlines as a way of getting around regulators' lack of resources, trained personnel and scope — regulators are restricted to judging based on what regulations require and nothing more. He said that while regulators may be able to define and quantify the organizational structure and data gathering elements of a safety management system, the status of a firm's safety culture "is hard or impossible to check. It is impossible to revoke an operating certificate because a company has a low safety culture," Gradisar said.

An inter-airline system has "adequate finances, adequate human resources and [potentially] unlimited scope." However, there also exists a commercial bias in such a system: "They want to make it work. This is better, but not good enough."

## Targeting Safety Criminalization

Flight Safety Foundation and Eurocontrol at the seminar announced that two Eurocontrol officials, Radu Cioponea and Tzvetomir Blajev, have been seconded to Flight Safety Foundation for two years to serve as Foundation Fellows campaigning to educate prosecutors about the negative consequences of post-accident criminal prosecutions and interfering with the immediate safety investigation of accidents.

— JD

Conventional regulators need to be overhauled by the addition of a dedicated oversight agency with access to a "registry of experts" drawn from the industry to conduct audits, Gradisar said. There also need to be added analysis and database functions to help the industry "to move beyond compliance." The resulting system can allow auditors to look beyond the regulations, and make a clear assessment of the state of an operator's safety culture.

Robert Sumwalt, member of the U.S. National Transportation Safety Board, was clear on the subject of safety culture: "If you think you have a good safety culture you are almost certainly mistaken. A safety culture is a journey, not a destination… . Safety has to start at the top of the organization and permeate throughout." NTSB investigates many accidents in which "the most common link is the attitude at the top of the organization."

Sumwalt cited the crash of a Cessna 310 (see story, p. 46) where "management commitment was not there. They did not have the policies and procedures in place to keep an unairworthy aircraft from becoming airborne with a known and unresolved discrepancy."

Also cited by Sumwalt was a company that gave maneuver guides only to its chief pilot and instructors, an airline that permitted crews to use an automated system for the first time in line service and a regional airline that had no way of knowing if procedures had been followed other than that the airplane "arrived on time and took off on time."

Sumwalt said, "You track engine health with multiple gauges. Wouldn't you like to have multiple sensors to keep informed about the health of your safety culture? You have these sensors, your employees."

Nick Mower, vice president technical services for the European Regions Airline Association, said there is a need for the European Aviation Safety Agency to strengthen its safety focus and establish priorities, instead of devoting too much time to transcription and documentation. "EASA has yet to develop a clear safety roadmap," he said. Part of the problem is that EASA regulations lack "teeth" due to the weakness in the legislation that established EASA, and lacks a European Union–wide aircraft registry.

The absolutely essential nature of data to the safety process was highlighted by Eric Merckx, deputy director, air traffic management programs, Eurocontrol: "It is criminal if you don't share [safety information]. Indications are that only 20 percent of incidents are being reported [because] air traffic controllers and pilots are still afraid to report out of fear of criminal prosecution. We need to tell prosecutors how important reporting is to protect passengers." (See "Targeting Safety Criminalization," p. 17)

"Safety has stopped improving since about 2003," according to his analysis of data, said David Learmount, operations and safety editor, Flight Group. "We need to go beyond compliance. Excellence, rather than just staying within the law, must be the objective."

An example of this failure to reach beyond the rules is the industry's failure to adopt jet upset training despite a Boeing study that clearly showed the training benefits, he said. "There is no requirement to provide such training; we need to go beyond compliance," he repeated.

Another operational element that needs to be examined is the psychology behind pilots' actions during non-revenue flights, Learmount said,

Mower (left), Learmount and, from left, Gradisar, Vecko, Dick van Eck (air traffic controller, The Netherlands), and Rausel.

pointing at the Air New Zealand/XL Air Airbus A320 accident during acceptance testing off the coast of France. In addition, he said, "we have to do more study of pilots flying highly automated aircraft," noting the possible role automation played in the crash of a Turkish Airlines Boeing 737-800 just short of the runway at Amsterdam Schiphol Airport.

Learmount also charged that the industry, "despite the respite granted by the economic downturn, has taken its eye off the ball dealing with the shortage of trained labor," a refrain echoed by Emile Rausel, director of training engineering at ATR. Rausel pointed out that pilot skill levels must cope with increased aircraft automation, especially in emergency situations, congestion, accelerated training and minimal recurrent training.

Part of this economic pressure for regional airlines is having to cope with training programs developed by and for major carriers that focus on full flight simulators (FFS) with motion despite the relative scarcity of FFS for regional aircraft. Also, there are increased requirements for mandatory exercises in the same amount of simulator time. The result, Rausel said, is "cockpit proficiency is decreasing." In addition, operators found that "students starting in the ATR did not have adequate skills; they needed more [simulator] time."

However, while an FFS costs as much as an ATR 42, a new high-capability fixed base training device (FFT-X) has been developed that costs about $4 million that, in a modified training program that adds a few weeks to the introductory training process, allows pilots to develop a much deeper understanding of aircraft systems, Rausel said. These new simulators, deployed in a network of training centers, have been accepted for recurrent training in Poland, Italy, Venezuela and New Zealand, while France, the United Kingdom, Brazil, Oman and Fiji have accepted them for checking and recurrent training.

Call sign confusion leads pilots to deviate from air traffic control (ATC) clearances, said Richard Lawrence, deputy manager, Eurocontrol contingency planning project. A Eurocontrol study showed that call sign confusion usually involves two or more aircraft from the same company, with 14 percent of confusions resulting in an altitude deviation. Only the French air navigation service provider, Direction des Services de la Navigation Aérienne, had a program to de-conflict call signs until Eurocontrol last year launched a three-stage, three-year program that intends to eliminate 80 percent of call sign similarities that lead to confusion events, Lawrence said. A major element in the effort is pushing call signs away from numbers-only into an alphanumeric combination. Attention also is being paid to the last letter of the call sign, often the key to a confusion incidence, designing flight number scheduling schemes to keep identical "last letter" call signs out of the same airspace.

Up to 50 percent of all traffic alert and collision avoidance system (TCAS) resolution advisories (RAs) are unnecessary and can be a significant nuisance, said Martin Vecko, director of flight safety at CSA Czech Airlines. These unnecessary RAs can create aircraft handling problems by over-responding pilots, a pilot input opposite to the RA and even the reduction in separation with aircraft not involved in the initial encounter. Many of these unnecessary RAs are triggered by the high vertical speed of aircraft climbing or descending to an altitude that will not cause a conflict, but sets off the look-ahead feature of TCAS.

TCAS is a valuable tool and its warnings must always be acted upon immediately, leaving event evaluation for later, he said, but the system would be safer overall if unnecessary RAs can be reduced. The problem, Vecko said, is that modern aircraft have normal climb rates well in excess of the rate that will not trigger an RA. While Eurocontrol recommends a rate of 1,000 fpm in the last 1,000 feet of the climb, and International Civil Aviation Organization suggests 1,500 fpm, the vertical speeds in any autoflight mode available on CSA's 737s and A320s, based on a flight data monitoring study, "are significantly higher than the recommended values."

At present the best solution is for pilot intervention into the autoflight settings to manually reduce the climb rate, "but the reduction must be timely," Vecko said, with hope that eventually manufacturers can modify the autoflight altitude capture laws. Also possible is a redesign of TCAS logic (see story, p. 34) or new ATC route systems that avoid simultaneous horizontal and vertical aircraft convergence, Vecko said. Given the time required to redesign systems, Vecko recommended that pilots "push one more button before leveling off" as the best approach to take today.

The development of a landing overrun risk assessment index through a joint airline, university and Netherlands' National Aerospace Laboratory (NLR) effort was described by Gerard van Es from the NLR Air Transport Safety Institute. He said that data show that overruns are a rising proportion of total accidents. Using data from 182 overrun accidents and quick access recorder data from 14,000 landings, the team constructed a risk index that involved as many as 35 risk factors. The Landing Overrun Risk Index (LORI) has been successfully demonstrated and is available to help manage the risk of an overrun, van Es said.

# KNOCK YOURSELF OUT

**Overreaction to a shattered windshield led to loss of consciousness and control.**

BY MARK LACAGNINA

The Raytheon King Air B200 was cruising at 27,000 ft when the pilots heard a loud snap and saw a web of cracks appear in the left windshield. Procedures for dealing with a shattered windshield were not on the one-page collection of truncated checklists aboard the airplane. Fearing groundlessly that the windshield might blow out, the pilot depressurized the cabin. Both pilots then donned their oxygen masks — but failed to notice that the oxygen system shutoff valve was closed.

With the cabin depressurized and no oxygen flowing into their masks, the pilots momentarily lost consciousness. The King Air descended out of control for about five minutes, losing 17,600 ft of altitude. The windshield held, but the tail was shredded as aerodynamic loads reached at least 4 g — that is, four times standard gravitational acceleration — during the uncontrolled descent and the pilots' eventual recovery from the dive. Damage was substantial, but the pilots escaped injury and were able to land the airplane without further incident.

In its final report, the U.S. National Transportation Safety Board (NTSB) said that the probable cause of the accident was the "pilot's poor judgment before and during the flight, including turning the oxygen system ready switch

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The King Air's tail was extensively damaged during the uncontrolled descent and the pilots' recovery from the upset.

[i.e., the shutoff valve] to the 'OFF' position after he conducted the preflight inspection and using an unapproved checklist, which did not provide guidance for a fractured windshield and resulted in his depressurizing the airplane."

This statement of probable cause, however, did not result from consensus among the NTSB's five members. A dissenting statement was filed by one member who contended that the shattering of the windshield resulted from a design defect and should have been cited as a contributing cause of the accident. Another safety board member concurred.

## Positioning Flight

The accident occurred on Feb. 2, 2007, during a positioning flight from Rogers, Arkansas, to Staunton, Virginia, in visual meteorological conditions. The report said that the King Air was operated by the Assembly of God.

The pilot, 31, was employed as a company pilot. He held an airline transport pilot certificate and had 4,048 flight hours, including 110 hours in type. "The pilot completed a flight review during B200 training at SimCom International on Aug. 24, 2006," the report said.

"A noncompany pilot, who had not attended or completed a training course or received a checkout for Raytheon … King Air 200 airplanes, was asked by the company pilot to accompany him on the flight so that the noncompany pilot could accumulate flight time."

The copilot, 28, had commercial pilot and flight instructor certificates with multiengine airplane ratings. He had 2,806 flight hours, including 557 hours in multiengine airplanes and 28 hours in the King Air.

The airplane was manufactured in 1998 and had accumulated 1,835 service hours. "The pilot's windshield … was installed at the time of the airplane manufacture and subsequently had not been overhauled or repaired prior to the accident," the report said. "There were no previous reports of delamination or cracking."

The shattering of the inner ply of the left windshield was traced to a fracture within the glass.

## 'Don't Tear It Up'

The King Air departed from Rogers Municipal Airport at 0839 local time. The report said that cockpit voice recorder (CVR) data indicated that the pilot left the cockpit shortly after the airplane was established in cruise flight at 27,000 ft at about 0900. The pilot said that he was going to "fetch the trash can" and told the copilot, "Don't tear it up while I'm gone."

About four minutes later, the CVR recorded the sound of a very loud snap and the copilot calling the pilot's name. "[This] indicated that the company pilot was not in the cockpit when the windshield fractured because he was emptying trash in the cabin," the report said. "This action showed poor judgment, considering the noncompany pilot was not qualified in the airplane."

After the copilot called his name, the pilot said, "What did you break?"

The inner ply of the left windshield had shattered. According to the B200 airplane flight manual (AFM), this is an abnormality, not an emergency: Although small particles may separate from a shattered inner ply, the windshield is designed to remain in place.

The "Abnormal Procedures" section of the AFM includes a checklist titled "Cracked or Shattered Windshield." A note at the top of the checklist says, "The following procedure

## Raytheon King Air 200B

© Mick Bajcar/Airliners.net

Beech Aircraft began deliveries of the Super King Air 200 in 1974. The airplane shares the same basic fuselage with the King Air 100 but has a longer wing, a T-tail and more powerful engines — 850-shp (634-kW) Pratt & Whitney PT6A-41s. Raytheon acquired Beech in 1980 and shortly thereafter introduced the B model with PT6A-42 engines, which provide improved cruise performance and a higher — 6.5-psi — maximum cabin-pressurization differential.

The prefix "Super" was deleted from the names of the 200-, 300- and 350-series King Airs in 1996.

In standard configuration, the King Air B200 accommodates a pilot and seven passengers, and has a maximum takeoff/landing weight of 12,500 lb (5,670 kg), a maximum cruise speed of 289 kt, a service ceiling of 35,000 ft or 21,735 ft with one engine inoperative, and a range of 1,461 nm (2,706 km) at 25,000 ft.

Hawker Beechcraft, formed in 2007, currently produces the King Air 200GT and 350 models.

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

should be used when one or more cracks occur in the inner or outer ply of the windshield. The procedure is also applicable if the windshield shatters. This usually occurs in the inner ply and is characterized by a multitude of cracks which will likely obstruct the crewmember's vision and may produce small particles or flakes of glass that can break free of the windshield."

The checklist procedure comprises the following actions:

- Maintain an altitude of 25,000 ft or lower "if possible."
- Maintain a cabin differential pressure of 2.0 psi to 4.6 psi during cruise and descent.[1]
- Depressurize the cabin before landing.

The checklist also includes the following "in-flight considerations":

- "Visibility through a shattered windshield may be sufficiently reduced to dictate flying the airplane from the opposite side of the cockpit;
- "Precautions should be taken to prevent particles or flakes of glass from a shattered inner ply of the windshield from interfering with the crew's vision;
- "A cracked outer windshield ply may damage operating windshield wipers;
- "Windshield heat may be inoperative in the area of the crack(s); [and,]
- "The structural integrity of the windshield will be maintained."

The checklist refers the user to the "Limitations" section of the AFM for postflight considerations. Basically, the airplane can be flown for up to 25 hours after cracks appear in either the inner ply or the outer ply of the windshield. However, if both plies are cracked or if an inner ply has shattered, the windshield must be replaced before further flight.[2]

### Homemade Checklist

The pilots did not consult the AFM after the windshield shattered. "An unapproved document, not derived from the AFM, that contained several checklists was found on the airplane," the report said. "The company pilot stated that he used this document and that it 'came with the airplane.' The document did not include a checklist addressing a cracked or shattered windshield."

The pilot told investigators that he depressurized the cabin because he did not know what had caused the windshield to shatter and whether it would remain in place. This indicates that the pilot did not know that the shattered windshield did not present an in-flight emergency and that there was no need to depressurize the cabin, the report said.

After the pilot selected the pressurization "DUMP" switch, the copilot said, "We need to go on oxygen." The pilot replied, "Yeah." They donned their oxygen masks but found that oxygen was not flowing into the masks. "Can't get no oxygen," the pilot said. "I ain't getting no oxygen. … You got oxygen?"

That was the last statement recorded by the CVR. "After this time, the only crew noise was the sound of the copilot breathing erratically," the report said.

## Shutoff Valve Shut

The pilot told investigators that he pulled the oxygen-system control knob on the left side of the center console to open the shutoff valve on the oxygen cylinder, which places the oxygen system in the ready mode, but "it was hard to pull and did not seem to engage properly."

The oxygen cylinder is located behind the aft cabin firewall. The oxygen system shutoff valve on the cylinder is connected to the cockpit control knob by a cable (Figure 1). Opening the shutoff valve is among the actions specified by the "Before Start" checklist — as well as by several emergency checklists — in the AFM, but it was not included in the truncated "Before Start" checklist that the pilots were using.

"Oxygen will flow to each mask only if the oxygen tank shutoff valve is in the 'OPEN' position," the report said.

The pilot told investigators that he opened the shutoff valve during preflight preparation to check that the oxygen system was functional but then closed the valve because he was concerned that the oxygen would be depleted if the valve remained open.

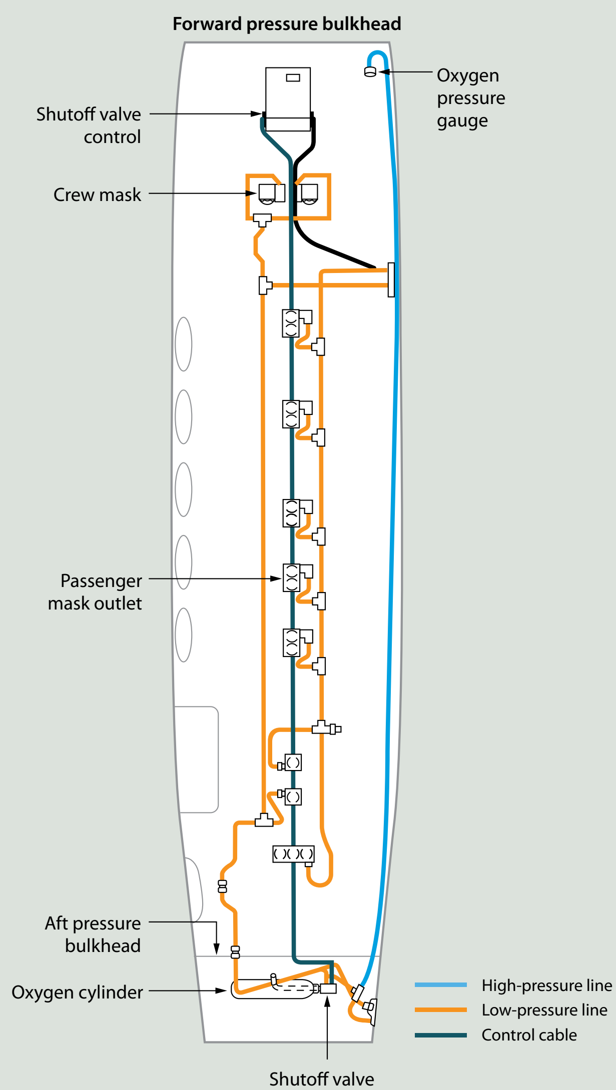
After the accident, the oxygen shutoff valve control knob was found in the "OFF" position. "Functional testing of the oxygen system revealed normal operation," the report said. "The unapproved-checklists document did not include the instruction to leave the oxygen system on. Regardless, the pilot stated that he knew the approved checklist stated to leave the oxygen system on but that he still chose to turn it off. The pilot exhibited poor judgment by using an unapproved, incomplete checklists document and by knowingly deviating from approved preflight procedures."

The report said that the pilots likely either forgot to open the oxygen system shutoff valve after depressurizing the cabin or lost consciousness before they could do so.

## 'Not Thinking Clearly'

The pilot said that soon after he depressurized the cabin, he developed tunnel vision and

**King Air B200 Oxygen System**




Source: U.S. National Transportation Safety Board/Susan Reed

**Figure 1**

had trouble thinking clearly.[3] He told investigators, "The last thing I remember, although not clearly, at this phase of flight was beginning an emergency descent. I disengaged the autopilot and pitched down but never made it to reducing power to idle or extending the landing gear."

Only two air traffic control (ATC) radar data points were recorded during the uncontrolled descent. The first showed the King Air at 25,400 ft at 0917:45; the second showed the airplane at 7,800 ft at 0922:59.

The pilot told investigators that he did not remember clearly what happened when he regained consciousness. "I remember the airspeed pegged, so I immediately reduced power to idle and began pitching toward a level attitude slowly," he said. "Due to very limited vision from oxygen deprivation, a shattered windshield and a failed attitude indicator, overcoming disorientation was very difficult. After an unknown amount of oscillations, satisfactory control of the aircraft under present conditions was obtained at approximately 7,000 ft."

He declared an emergency with ATC and requested, and received, vectors to the nearest suitable landing site, Cape Girardeau (Missouri) Regional Airport. "Although the aircraft was difficult to control, a successful landing was made with no injuries sustained," the pilot said.

The fact that the airplane had been subjected to aerodynamic loads of at least 4 g was established by the position of the CVR impact switch. The switch, which was found open, is designed to open automatically — and deactivate the CVR so that data are preserved — if the airplane is subjected to an acceleration force of 4 g.

"On-scene examination of the airplane noted that approximately two-thirds of the left horizontal stabilizer and elevator were separated from the airplane, and two-thirds of the right elevator was separated but attached at the inboard hinge," the report said. "The left and right wing [skins] were wrinkled. The left pilot windshield outer and inner plies were intact. The inner ply exhibited a shattered appearance with a crack at the lower right-hand corner of the windshield." In addition, the rear fuselage was buckled.

## 'Possible Anomaly'

The windshield, which consists of thermally tempered glass plies with a vinyl layer between them, was examined by the Research Laboratory Materials Integrity Branch at Wright-Patterson Air Force Base in Ohio. "There was no evidence of fractures or any other damage on the windshield's outboard surface or within the outer glass ply," the report said.

The shattering of the inner pane was traced to a "peel chip fracture" at the bottom center of the pane. "Scanning electron microscope examinations conducted of the glass fracture at the peel chip initiation revealed evidence of the initiation at a possible anomaly in the glass," the report said.

The windshields installed in King Airs were redesigned in 2001 to incorporate a urethane layer between the vinyl interlayer and the inner glass ply that relieves stresses on the glass ply. "No known similar fractures have occurred in the newly designed windshield," the report said. "The manufacturer chose not to issue a service bulletin for a retrofit of the new windshield design in airplanes manufactured before 2001 because the fracture of one pane of glass is not a safety-of-flight issue."

## 'Not an Aberration'

NTSB member Deborah Hersman did not agree with the probable-cause statement approved by the majority of the board members. Board member Robert Sumwalt concurred with the dissenting statement that she included in the public docket for the investigation.

Hersman pointed to 160 service difficulty reports (SDRs) of King Air windshield fractures that were submitted to the U.S. Federal Aviation Administration (FAA) between 1995 and 2007. "In a number of the cases cited in the SDR data, the crew failed to take the appropriate action," she said. "So, while this crew's reaction to their fractured windshield was poor, it was not necessarily an aberration.

"The fracturing of the windshield on this aircraft, which was due to a design defect, set in motion the crew's reaction that led to the accident. If the windshield had not failed, the crew would not have had the occasion to take any responsive action, appropriate or otherwise, and this accident would not have occurred. For that reason, I believe the fracturing of the windshield should be cited as a contributing cause of this incident."

The report was based on a limited investigation of the accident, and no recommendations were issued by NTSB.

*This article is based on NTSB accident report no. CHI07LA063, issued on Nov. 20, 2008, and on public docket no. 65268.*

### Notes

1. The checklist notes that with a cabin differential pressure of 4.6 psi at 25,000 ft, cabin altitude is approximately 10,500 ft. Maximum differential pressure is 6.5 psi.
2. A special permit can be requested from the FAA to conduct a ferry flight to a repair station.
3. According to the FAA, loss of peripheral vision and impaired decision-making ability are symptoms of hypoxia, or oxygen deficiency; time of useful consciousness at 27,000 ft is about 90 seconds.

# Flight Safety Foundation–International Is 20

**From its birth in the last years of the U.S.S.R., FSF–I advanced to hosting the International Air Safety Seminar.**

BY VALERY SHELKOVNIKOV AND DMITRI TARASEVICH

The life of an organization, like that of a person, should not be viewed apart from the social and political periods to which they belong.

At the end of the 1980s, perestroika and glasnost became powerful influences on the course of events in our society. After dozens of years behind the "Iron Curtain," our society began to move more freely than before, and international contacts multiplied. At the same time, the aviation community, as with society in general, felt something unseen and unknown coming.

But only the people at the top knew that serious problems were at hand. Oil prices were plummeting, and the state budget was in great disarray. Many thought that state flight safety programs were facing a financial guillotine. Aviators concerned with safety were writing letters of alarm to Mikhail Gorbachev, then premier of the Union of Soviet Socialist Republics (U.S.S.R.), but they received only formal replies.

Despite these concerns, other actions were at work. The Soviet government sent a delegation to the United States to discuss with the State Department and Federal Aviation Administration (FAA) the possibility of commencing operations from North America to Southeast Asia via routes over the U.S.S.R. If this possibility could be realized, the world of international air traffic would be changed dramatically, with great reductions in en route time and cost.

It so happened that while those of us in the delegation were in New York City, visiting the FAA air route traffic control center, we met John Enders, president and chief executive officer of Flight Safety Foundation (FSF). An engaging and experienced engineer, air safety expert and former aviator, John briefed us on how the independent Foundation originated in 1947 and subsequently expanded its operations to enhance flight safety worldwide. He encouraged us to consider this as a model for the U.S.S.R. in addressing aviation safety challenges.

After returning to Moscow, we shared the idea of setting up a similar organization with prominent

FSF-I awards ceremony at Petrovsky Palace, Moscow, 1997. Standing: Valery Shelkovnikov, FSF-I president.

figures in Soviet aviation. Ivan Mashkivskiy, chairman of the State Safety Oversight Agency; Tatiana Anodina, head of one of the principal research and development institutes; Air Force Maj. Gen. Alexey Mayorov, Premier Gorbachev's chief pilot; Air Force Col.-Gen. Ivan Modiaev, First Deputy Air Force General Staff; Gennady Bocharov, prominent journalist and member of the Writers Union; and many others enthusiastically supported this idea. It seems that some had nurtured similar thoughts for many years.

All of them joined a new steering committee that was set up to devise a way of bringing these ideas to reality. Everybody understood that:

First, even the most developed state aviation system is not in a position to cover the entire spectrum of problems;

Second, state organizations are not flexible and proactive enough; and,

Third, state personnel, being dependent on numerous other government bodies, may not demonstrate independent, objective and unbiased approaches to developing permanent safety solutions.

Our lawyers quickly advised us of the difficulties we faced in forming such an organization. There was no law in the U.S.S.R. that would allow for the creation of a public organization. Somebody told us that even the powerful Communist Party, as a de facto "public organization," had been illegally functioning for more than 70 years; life was not simple. It was Gennady Alferenko, a young, joyful and adventurous character, and president of the Social Innovation Foundation of the U.S.S.R., who provided us with a means of achieving our goals. In love with aviation, he promptly helped us to draft papers necessary for joining his Foundation under the name "Association Flight Safety Foundation U.S.S.R. (AFSF-USSR)" and his huge official stamp breathed life into our organization. We were the ninth group existing under his approval umbrella. After that, no matter whether public organization legislation existed in the U.S.S.R., we were allowed to open bank accounts.

Alexander Neradko, director of Russian Federation Air Navigation Authority (left), with Stuart Matthews, FSF president and CEO, Moscow ALAR workshop, 2003.

The principal goals of our new organization were almost 100 percent modeled on the Flight Safety Foundation as described to us by John Enders. We undertook to communicate safety information; award aviators for heroism, bravery and resourcefulness; advocate flight safety and international experience; hold international flight safety workshops; and perform other initiatives to instruct our nation's aviation personnel and inform the international community about Soviet aviation.

The first person to react to media information about our new association was Anna Pavlovna Smirnova. She wrote: "My sons, accept three rubles in the enclosed envelope. I am retired and that is all I can do for you. Fight for flight safety. My only son was killed in an air accident."

After reading this message, we realized in our hearts the serious responsibility we had taken upon our shoulders.

Cooperation with the Foundation had become our priority. Unique information on accident prevention from the Foundation was disseminated among our corporate members. We organized a number of joint international flight safety workshops, awarded Russian aviators both with the Association's and FSF's awards. Helicopter test pilot Anatoly Grischenko was the first Russian to receive the highly esteemed FSF Heroism Award, the Graviner Sword, for his rescue operations at the Chernobyl nuclear reactor accident site in Ukraine. The award was presented posthumously to his wife at Flight Safety Foundation's International Air Safety Seminar in 1990. Innokenty Tsivilev, a Mil Mi-8

## Afterword

Shelkovnikov and Tarasevich's comprehensive account of FSF-I's beginning and growth noted the influence and support of Flight Safety Foundation (FSF) in nurturing FSF-I. Here's how it happened:

In 1980, FSF's board of governors wanted to broaden the organization's membership. It then stood at about 150 organizations, but all were outside the Communist Bloc. Since the FSF charter called for fostering the safety of civil air transportation worldwide, that implied sharing operational safety information and practices among all operators. Efforts began to bring the General Administration of Civil Aviation of China (CAAC) and the Union of Soviet Socialist Republics (U.S.S.R.) Ministry of Aviation into dialogue with the Foundation through our seminars, forums and publications, and to share knowledge and lessons learned with them.

Correspondence began in 1982 with the U.S.S.R. minister of aviation, Marshal Bugayev, as well as with the CAAC through its New York office. We invited each to send representatives to FSF international seminars and become acquainted with our work, aiming to bring them into full membership. Neither the U.S.S.R. nor China well understood the Foundation's charter as an independent, non-government and non-profit international organization, or its mode of operation. Meanwhile, we sent complimentary copies of our safety bulletins to both CAAC and the U.S.S.R.

The Internet did not exist at the time. Eventually, a teletype reply arrived from Marshal Bugayev. Soon, the U.S.S.R. sent two representatives, Nicolai Safranov of the State Supervisory Committee and Yuri Kostev of the Gromov Flight Research Institute, to our 1988 International Occupant Safety Conference and Workshop in Arlington, Virginia, U.S. We had intensive discussions with them about the Foundation's organization and operation.

A Soviet air traffic control delegation led by Valery Shelkovnikov was visiting the U.S. Federal Aviation Administration (FAA) at the time of our conference, and Safranov and Kostev briefed Shelkovnikov about the Foundation on their return flight to the U.S.S.R.

Shortly, we received a message from Sergei Tcheremnykh, on behalf of Shelkovnikov, that began mutually supportive efforts by suggesting a meeting, facilitated by the FAA, at the New York Terminal Radar Approach Control. We described our organization, means of funding, collaborative information exchange with members, feedback through industry advisory committees and other administrative matters, hoping it would serve as a template for them.

Soviet participation in our seminars began with our 1989 42nd international seminar in Athens, where Drs. Krylyk and Mirinov presented a paper on catastrophic risk. Russian delegations have attended and participated in our seminars ever since.

In 1990, FSF General Counsel Bob Gray and I met with senior Russian aviation experts and visited many departments and institutions in Moscow and Leningrad to explain the FSF concept and to urge Soviet support for their own fledgling foundation.

Our subsequent visits included lectures to officials, students and industry leaders about aviation safety and how it was practiced in the West, emphasizing that we would provide help as they proceeded with their own approaches to safety improvement, and eventually in joint sponsorship of safety colloquies and workshops throughout the new Commonwealth of Independent States.

Stuart Matthews, FSF president and CEO, and I maintained vigorous support of and cooperation with our FSF-I friends, which continues under the current president and CEO, William R. Voss.

— John Enders

*John H. Enders is former president, CEO and vice chairman, Flight Safety Foundation, and honorary president, FSF-I.*

transport helicopter flight engineer, was the second Russian recipient, in 1997.

These activities made the Association highly visible in the aviation community, and drew support from industry, government and individuals. The number of corporate members quickly grew to 100.

The first Association revenue was used to disseminate more than 1,000 copies of the International Civil Aviation Organization (ICAO) *Accident Prevention Manual* among Russian aviation organizations. We knew that only about 50 copies of this vitally important report describing modern concepts and accident prevention methods had been sent to Russia from ICAO headquarters, and could be found only on the desks and bookshelves of the "big shots," while those who vitally needed this information, the operations personnel, were deprived of it. That is why we considered this move as a type of "missionary" work aimed at enlarging the circle of like-minded persons and raising safety awareness among them. As a result, many aviators began to speak our common safety language and, more importantly, to apply the principles it described.

In 1990, responding to a request of the Federation of Amateur Pilots of the U.S.S.R., our Association organized and led a seven-light-plane formation flight over an adventurous and challenging route: Moscow-Siberia-Alaska-Canada-Seattle and return to Moscow. The flight was a success and took a month and a half. Our purpose was to attain some familiarity with U.S. general aviation activities. Although the flight was sponsored by Russian businessman and amateur pilot Grigory Komarenko, without the assistance rendered by our friend and former FAA administrator, the late U.S. Navy Vice Admiral Donald D. Engen, we would never have been able to make it.

His authority helped us to solve all the problems of coordination with U.S.-Canadian North American Aerospace Defense Command systems in order for us to be able to cross the U.S.S.R.-U.S. border in the Bering Strait area. Later he demonstrated to us the democratic approach to airspace use. We had never seen such freedom of operations, even in Europe.

In October 1991, a "miracle" happened. The first deputy to the Minister of Jurisdiction granted registration documents to our organization. We were overwhelmed with joy! We had become a legitimate organization in the eyes of the government. As far as we know, it was some time later that the powerful Communist Party of the U.S.S.R. was similarly registered!

On Dec. 8, 1991, the U.S.S.R. collapsed. In 1993, miraculously, the shelling of Parliament and attempted coup did not end in disaster. In 1998, we saw financial default. Not only were private persons within our corporate membership victimized, but institutions were badly affected. But we followed author Alexander Solzhenitsyn's admonition: "Do not trust, do not be scared, do not ask for a favor," and continued to work.

We were not afraid of contacting people at the top and criticizing, and we never took a single ruble from the state budget. Every year we organized the awards ceremony for aviators from the Commonwealth of Independent States (C.I.S.) member states. Together with ICAO, the International Air Transport Association (IATA), the Foundation and the FAA, we continued holding workshops and disseminating unique materials pertaining to international flight safety experience. In cooperation with the U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS), we established a similar voluntary reporting system.

Finnair became the first international airline to join our Association, making a significant contribution by supporting flight safety workshops, including those in Finland. The Anglo-Continental Education Group in England contributed heavily to the training of Russian and C.I.S. aviators and air traffic control personnel in English language proficiency, later joining our organization. Our Association's chairmen and the members of our board of governors exercised wisdom as their decisions and initiatives contributed to stable and efficient operations through many years of safety enhancements in this country. We cannot overestimate the important role in flight safety promotion played by the *Civil Aviation* magazine, the *AviaSoyuz* magazine, and the *Vozdushny Transport* newspaper.

**We had become a legitimate organization in the eyes of the government.**

Tirelessly, John Enders traveled all over the U.S.S.R. and C.I.S., lecturing on the most pressing issues of accident prevention and safety management.

Ten years later, taking due account of their inputs into establishing our organization, we decided to elect Enders the Association's honorary president and Mashkivskiy as chairman emeritus.

With Enders's retirement from the Foundation, a new and energetic successor president, Stuart Matthews, continued an excellent relationship with us, did a lot to improve it and suggested that the Association should be an FSF "sister organization." This initiative considerably enlarged our international contacts aimed at information exchange.

Recently, William R. Voss, succeeding Matthews, continued the cooperation.

We held extremely important international workshops at the beginning of the 21st century to discuss the FSF *ALAR Tool Kit* and controlled flight into terrain workshops designed to combat the principal "killers in aviation."

The FSF 58th annual International Air Safety Seminar in Moscow in November 2005, a joint meeting of the Foundation, IATA and the International Federation of Airworthiness, became a high point of our activities. Despite a cold and frozen Moscow, the theme "Safety Is Everybody's Business" attracted about 500 participants.

Our cooperation with the Foundation goes on. Bill Voss often comes to Russia to organize and take part in important conferences. His messages in *AeroSafety World* are translated into Russian and have become very popular among the Russian aviation community.

The international financial crisis we currently face is an opportunity for clever and talented people to demonstrate their abilities. Understanding this, we shall survive and continue our efforts to enhance aviation safety.

*Valery Shelkovnikov is the former president, Flight Safety Foundation–International.*

*Dmitri Tarasevich is the former vice-president, Flight Safety Foundation–International.*

**Selected Smoke, Fire and Fumes Events in the United States and Canada, December 2008–March 2009**

| Event Date | Flight Phase | Event Airport | Event Classification | Event Sub-classification | Aircraft Model | Operator Name |
|---|---|---|---|---|---|---|
| Dec. 2, 2008 | Climb | | Return to airport, unscheduled landing | Smoke in cockpit | EMB-145 | American Eagle Airlines |
| Crew reported on climb-out strong odor of smoke in cockpit. | | | | | | |
| Dec. 3, 2008 | Climb | | Unscheduled landing | Smoke in cockpit | EMB-120ER | SkyWest Airlines |
| Burning odor in cockpit and cabin accompanied by smoke. | | | | | | |
| Dec. 3, 2008 | Cruise | | Unscheduled landing | Smoke in cockpit | Boeing 757 | Delta Air Lines |
| Flight crew reported smoke and fumes in the flight deck. | | | | | | |
| Dec. 6, 2008 | Climb | | Unscheduled landing | Smoke in cockpit | B-100 | Corporate |
| During climb crew noticed odor of electrical smoke in cockpit. After leveling off, cabin crew noticed odor of smoke in cabin. $O_2$ masks donned. | | | | | | |
| Dec. 8, 2008 | Climb | Teterboro, New Jersey (TEB) | Diversion, unscheduled landing | Smoke in cabin | Cessna 750 | Corporate |
| Deptarting TEB flight crew reported at 40,000 ft smoke in the cabin, diverted to Port Columbus, Ohio (CMH) | | | | | | |
| Dec. 9, 2008 | Takeoff | | Emergency landing, return to airport | Smoke in cabin | Boeing 737 | Airtran Airways |
| Upon takeoff flight attendants reported smell of smoke in cabin. | | | | | | |
| Dec. 10, 2008 | Cruise | Milwaukee, Wisconsin (MKE) | Unscheduled landing | Smoke in cockpit | B-1900 | Corporate |
| On departure pilots reported smoke smell and sparks near the bottom of the first officer's windshield. | | | | | | |
| Dec. 11, 2008 | Climb | Houston, Texas (IAH) | Return to airport, unscheduled landing | Smoke in cabin, smoke alert | EMB-145XR | Continental Express Airlines |
| Crew reported a lavatory smoke warming in flight. The cabin filled with smoke minutes after takeoff. | | | | | | |
| Dec. 18, 2008 | Cruise | San Juan, Puerto Rico (SJU) | Diversion, unscheduled landing | Smoke in cockpit | Boeing 737 | Delta Air Lines |
| Burning smell in cockpit at cruise, diverted to SJU. | | | | | | |
| Dec. 21, 2008 | Climb | | Return to airport, unscheduled landing | Smoke in cabin | Boeing 737 | Aerovías de México |
| Aircraft returned due to smoke in the cabin. | | | | | | |
| Dec. 22, 2008 | Cruise | | Unscheduled landing | Smoke in cockpit | Falcon 50 | Executive Jet Aviation |
| Smoke in cockpit originating from center console/FMS. $O_2$ masks donned. | | | | | | |
| Dec. 24, 2008 | Cruise | Lexington, Kentucky (LEX) | Diversion, unscheduled landing | Smoke in cabin | EMB-145LR | Chautauqua Airlines |
| Crew reported a smoke smell from emergency row. Flight diverted. | | | | | | |
| Dec. 24, 2008 | Cruise | | Return to airport, unscheduled landing | Smoke alert, smoke in cabin, odor in cockpit | CL-600 | Chautauqua Airlines |
| In flight, the crew reported a lavatory smoke caution message. Then, reported light smoke in the cabin and smoke odor coming from the vents in the cockpit. | | | | | | |
| Dec. 28, 2008 | Climb | Orlando, Florida (MCO) | Return to airport, unscheduled landing | Smoke in cabin | EMB-190 | JetBlue Airways |
| Return to MCO. Fumes of unknown origin reported in cabin after takeoff. | | | | | | |
| Dec. 30, 2008 | Cruise | Columbus, South Carolina (CAE) | Emergency landing, return to airport | Smoke in cabin | CL-600 | Mesa Air Group |
| Crew returned to the field and declared an emergency due to smoke in the lavatory and aft cabin. | | | | | | |
| Jan. 9, 2009 | Climb | Newark, New Jersey (EWR) | Return to airport | Smoke in cabin | EMB-145XR | Continental Express Airlines |
| During climb-out, flight attendant smelled fumes and smoke in the cabin and lavatory. | | | | | | |
| Feb. 13, 2009 | Climb | Miami, Florida (MIA) | Return to airport, unscheduled landing | Smoke alert | ATR-72 | American Eagle |
| While climbing through 4,000 ft, smoke master warning occurred, aircraft diverted. | | | | | | |
| Mar. 12, 2009 | En route | | Emergency landing, return to airport | Fumes in cockpit, smoke alert | Boeing 757 | Continental Airlines |
| Lavatory smoke alarm sounded, followed by fumes in cockpit. | | | | | | |

Source: FAA, SDR (Service Difficulty Report) data compiled by Safety Operating Systems




# Bucking Convention

**Symposium showcases innovations to reduce crew turbulence injuries and hold accountable passengers who impede safety.**

BY WAYNE ROSENKRANS

The sheer number of hours spent moving about an aircraft cabin leaves flight attendants more vulnerable than passengers to the risk of injury from a severe turbulence encounter. Several presenters explored this safety disparity during the International Aircraft Cabin Safety Symposium (CSS) conducted by the Southern California Safety Institute in February 2009 in Torrance, California, U.S.

In February 2008, serious injuries to two flight attendants aboard a Boeing 737-600 prompted Scandinavian Airlines (SAS) Norway to institute several changes, said Anne Lea Wittrup-Thomsen, an air purser, cabin safety coordinator and cabin investigator assigned to assist the Accident Investigation Board Norway for this accident.

"About 10 minutes to landing at Trondheim, Norway, the 'FASTEN SEAT BELT' sign had been switched on at 12,000 ft and the aircraft was crossing over a lake at approximately 7,000 ft," Wittrup-Thomsen said. "The two aft cabin crewmembers were making final preparations before landing and were about to sit down. One had reported 'cabin clear' [to the flight deck] when they could feel several hard shaking [forces] from the tail of the aircraft, later described as a sideways shaking … and both cabin crewmembers were lifted from the floor and hit their heads against the ceiling. Both came around on the floor after a little while."

One then told the other that she had pain in her tailbone and back; she crawled along the aisle and called for help from passengers. The other flight attendant whispered to her colleague that she was having difficulty breathing. A nurse and a physician on the flight immediately assisted them, including administering oxygen.

The flight attendant who had difficulty breathing, initially considered the most serious case, was treated for broken ribs at a hospital and released the same day to a hotel; she returned to her home base city the following day but remained off duty for about six weeks. "The other cabin crewmember had swelling and fluid in her spine which made [her condition] difficult to diagnose," Wittrup-Thomsen said. "She returned to base in the afternoon of the same day. A full body X-ray detected a week later that she had a broken vertebra. She was off on sick leave for two months."

Policy and procedures were revised in mid-2008 to require that cabin crews complete all cabin duties, occupy their jump seats and fasten their harnesses by the time the flight crew signaled descent below 15,000 ft. "Turbulence is more serious in the aft than in the front, and we opened up a dialogue so cabin crew working in the aft can call the flight deck and tell the pilots to switch on the 'FASTEN SEAT BELT' signs when they experience turbulence," Wittrup-Thomsen said.

Lufthansa also has tackled this risk of injury. The airline now *requires* — not *recommends* — that passengers keep their seat belts fastened whenever they occupy their seats. This policy was implemented in 2008, said Matthias Honerkamp, a captain, check pilot on Airbus A330 and A340 fleets, and manager of training standards and crew safety training, and Grit Matthiess, a purser for the airline.

"FASTEN SEAT BELT" signs formerly had been illuminated by the flight crew — often without a public address announcement — to signal passengers to be seated even during light chop and meal service typically was continued. Each time, however, the cabin crew had to walk the aisles, sometimes interrupting meal service or leaving the security of their jump seats, to check that passengers had fastened their seat belts. The signs so often were illuminated for long periods without an explanation that they lost their warning effectiveness.

"Our key case in August 2003 was an A340 accident during a climb to Flight Level 240 [about 24,000 ft] on the way to Houston," Honerkamp said. "The aircraft was lifted up with 2.3 g [2.3 times acceleration by gravity] and then was pushed down with minus 0.9 g within two seconds. We had two passengers with serious injuries and [40] passengers and three cabin crewmembers with minor injuries. One finding was that the seat belt signs had been switched on before the encounter, but despite that, many people had their seat belts unfastened."

Lufthansa's new policy requires a public address announcement with each illumination and guides flight crews on when to illuminate the signs. "If we expect moderate turbulence or we encounter moderate turbulence, we are required now to switch on the 'FASTEN SEAT BELT' signs," Honerkamp said. The legal authority behind the policy comes from a brief change to contractual terms and conditions of carriage accessible via a link on the home page of the Lufthansa Web site.

Auditing allows trained observers to see how time constraints in line operations affect readiness for turbulence encounters and performance of other safety duties, said Nina Haubold, manager cabin audit, Flying Operations Audit, Qantas. "For unanticipated turbulence during

Below, foreground left-right, Karen Allbright, Bernadette Jean, Brian Buchanan and Julie Pelletier of the Air Canada Component, Canadian Union of Public Employees; below right, Wittrup-Thomsen.

Photos: Wayne Rosenkrans

flight, cabin auditors really look at what is out there in our cabins during service time that potentially can harm the cabin crew and our passengers," Haubold said.

A line operations safety audit (LOSA) program for the cabin has made 360 observations since 2005, with each aircraft fleet audited at intervals of 18 to 24 months, she said. The 20 Qantas cabin safety auditors — each observing four sectors per year — are fully qualified, current and operational cabin crew who have received formal training in systemic threat and error management (TEM) principles and how to code qualitative human factors as threats, errors and undesired aircraft states.

After the cruise phase of flight, the highest rate of threats has been observed during the period from the preflight briefing until the final door has been closed for departure. "The high-ranking errors are failures to complete [all components of] the emergency equipment–effective checks preflight," Haubold said.

Benefits of cabin LOSA audits have included higher awareness of safety responsibilities among cabin crew; enhanced policies and procedures; new recurrent training on normal operating procedures; updated, reorganized and tightly controlled content revisions in cabin crew manuals; new cabin standard orders that supersede manuals between revisions; upper management tracking of agreed actions to fix issues noted in audit findings; improved communication; and more disciplined cabin safety operations committee meetings.

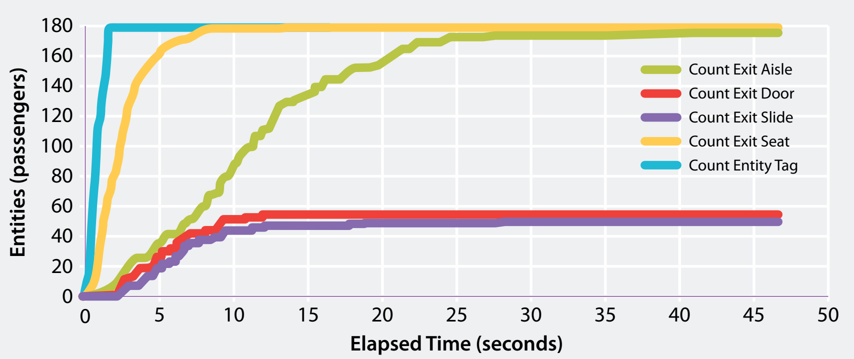
U.S. airlines can gain expanded flexibility to design their training under the voluntary Advanced Qualification Program (AQP) of the Federal Aviation Administration (FAA) compared with following the regulations for standard flight attendant training, said Chris Hallman, founding principal of Great Circle Consulting. Among major differences are the AQP requirements to collect and analyze data about scenario-based flight attendant performance and proficiency, and elimination of inflexible programmed hours of training for greater efficiency under AQP.

"AQP programs also require a specific, rigorous instructional design foundation and focus on training instructors and evaluators … and building the idea of systems thinking," Hallman said. Nevertheless, the program is not for all airlines because of the two-year start-up and ongoing commitment of full-time technical staff, especially to handle data management, analysis and reporting to the FAA and management; rewriting of operational training manuals; and the difficulty of returning to conventional training.

Other presentations of the 2009 CSS also showcased innovations. For example, airlines of Japan since 2004 have collaborated frequently with police to manage unruly/disruptive behavior aboard commercial aircraft through safety-focused laws, clear warnings and procedures, rapid enforcement and stiff penalties, said Akemi Inukai, manager, corporate safety, for All Nippon Airways (ANA). "With this amendment to the law, we can take a more firm attitude toward any unruly behavior and will not hesitate to report it to the police or to another appropriate law enforcement authority if necessary," Inukai said. "The captain has the right to issue a prohibition order to cease [eight acts impeding safety aboard aircraft]. If acts are continued or repeated despite the prohibition order, the passenger is violating the law and may be subject to a fine up to ¥500,000 [about $5,090]." From 2004 to 2006, the major issues at ANA were smoking in the lavatories, using improper electronic devices and interfering with cabin crew duties, she said.

Innovative approaches also have improved medical diagnosis of adverse health effects in flight crews and cabin crews from workplace exposure to bleed air contaminants, defined as pyrolized engine oils and hydraulic fluids that leak

**Visualizing Emergency Exit Congestion**




**Note**: In this simulation of a large commercial jet evacuation based on queuing theory, all 180 passengers exited from seats after five seconds and aisles after about 25 seconds. Under crash conditions input to the evacuation model, however, only about 50 passengers could exit from doors and slides because of congestion at doors. The software actually plotted individual entities adjacent to others, overlapping or spread out along these five colored lines.

Source: Adapted from airplane evacuation graphics generated by Embry-Riddle Aeronautical University using Micro Saint Sharp, a product of Alion Science and Technology

**Figure 1**

into the aircraft cabin and flight deck air supply systems (*ASW*, 4/08, p. 48). Robert Harrison, a physician and clinical professor of occupational and environmental medicine at the University of California San Francisco, told the symposium that "better engineering and maintenance … elimination of the possibility that these [aircraft mechanical] systems could fail" will be a key to resolving this contentious issue.

As a member of the FAA-funded Occupational Health Research Consortium in Aviation and in collaboration with the FAA's Airliner Cabin Environment Research Center of Excellence, he participated in the August 2008 publication of the free 24-page *Exposure to Aircraft Bleed Air Contaminants Among Airline Workers: A Guide for Health Care Providers.* In February 2009, a new two-page reference guide also was posted at <www.ohrca.org> for use by crewmembers.

"The initial symptoms have to happen within 48 hours of exposure," Harrison said. "This is important because — if someone has a delayed effect and says, 'I had an exposure three months ago … I was fine, but now I have a problem' — I don't think we can consider that work-related. To my knowledge, there is no latency, no delayed effect."

To proponents of evacuation simulation technology, the A380 evacuation demonstration that Airbus conducted in 2006 represents more than a step toward launching a new airplane type, said Brian Peacock, a professor at Embry-Riddle Aeronautical University–Prescott [Arizona, U.S.] and a specialist in ergonomics engineering (*ASW* 1/07, p. 46, and *ASW* 4/08, p. 47). An evacuation demonstration only demonstrates one set of conditions, Peacock said.

"The trick is to simplify the model and then run it just like a demonstration — but we can run it over and over again with many different conditions," Peacock said. Operators ideally could model and consider factors such as disability, incapacitation, immobility, stumbling, reverse flows, aggression, cooperation, panic, kin behavior — individuals such as family members who try to stay together during an evacuation — and passengers who impede themselves and others by taking their carry-on baggage.

Using queuing theory, the variables can be expressed as relationships among the number of entities, that is, passengers and crewmembers; queue length; queue logic; entity speed from 1 to 6 mph (1.6 to 9.7 kmh); resources such as doors, aisles and flight attendant flow management and redirection; release conditions for when an unavailable resource becomes available; service activity constraints and rates; queue discipline; statistical distributions; branching within queues from jockeying, balking and reneging; and optimal throughput rates (Figure 1).

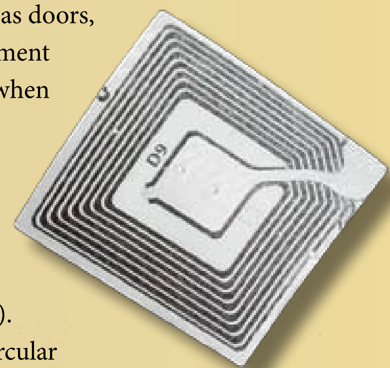
Since the publication of Advisory Circular 20-162, *Airworthiness Approval and Operational Allowance of RFID Systems,* in September 2008, the FAA has conducted an educational outreach to help flight attendants and other aviation professionals understand the nature of radio frequency identification (RFID) devices — often called *tags* — that look like a small foil strip or stamp with a microcircuit and possibly a battery or solar cell.

This part-marking technology will be used increasingly on galley/service carts, line-replaceable units in the electronics and equipment bay, baggage, mail containers and cargo devices. In the cabin, flight attendants may encounter RFID tags on passenger convenience items.

Tim Shaver, assistant manager of the Avionics System Branch, FAA Aircraft Certification Engineering Division, told the symposium that data stored in *passive RFID* tags can be collected when a reader or interrogator is nearby. In contrast, a *low-power active RFID* tag continuously transmits this data to readers or interrogators from a longer distance. Passive RFID tags inherently pose no risk to aircraft systems, but the designs of low-power active tags have to pass safety tests before they can be used aboard aircraft.

"If you have an RFID tag installed on every life vest on the airplane, a mechanic could walk through with a reader," Shaver said.

*To read an enhanced version of this story, go to <www.flightsafety.org/asw/apr09/cabinsymposium.html>.*




Top: © RA Photography/iStockphoto; bottom: © RF Code

Radio frequency identification devices (RFIDs) include the passive RFID, top, and the low-power active RFID.

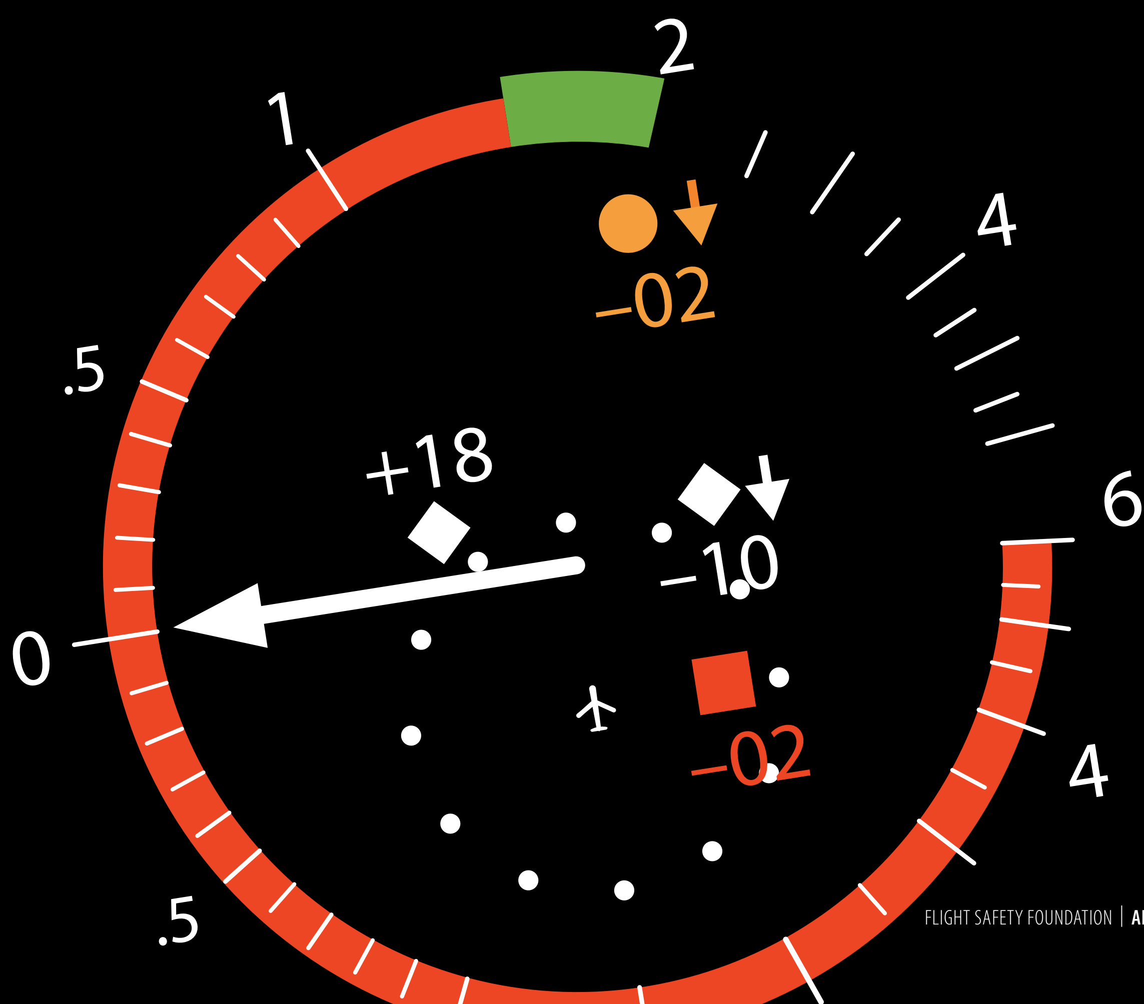
Traffic alert and collision avoidance system (TCAS II) Version 7.1 — a software upgrade developed by European and U.S. specialists — is expected to clear one of the last technical hurdles on its five-year path to operational readiness during April. Possibly by mid-2010, the upgrade installed in new TCAS II equipment will fix two serious problems in today's collision avoidance system logic and make other minor improvements. Strategic decisions on whether civil aviation authorities will recommend or require retrofitting Version 7.1 logic are pending.

One problem is that Version 7.0 logic does not reverse some resolution advisories (RAs) when a reversal is required to resolve the threat of collision between two equipped aircraft while both are climbing or descending within a vertical distance of 100 ft of each other. The other problem is flight crews with vertical speed TCAS II displays maneuvering in the wrong vertical direction after receiving one of four "Adjust Vertical Speed, Adjust" (AVSA) RAs. AVSA RAs, now considered ambiguous by many safety specialists, advise a pilot to reduce the aircraft rate of climb or descent to 0, 500, 1,000 or 2,000 fpm for collision avoidance, and they lack any upward or downward aural annunciation.

AVSA RAs have accounted for nearly two-thirds of all RAs in European airspace, occurring mainly in geometries involving level-off at 1,000-ft altitude increments as assigned by air traffic control (ATC). Pilot training solutions — for example, re-emphasizing that the

# Separation

**Imminent approval of software upgrade promises safer TCAS II collision avoidance system logic.**



# Anxiety

BY WAYNE ROSENKRANS

proper response to any AVSA RA is a reduction in vertical speed while maneuvering toward level flight — alone have not worked, European specialists say.[1]

Version 7.1 solves the first problem with a significant software code change that monitors compliance with RAs and enhances the reversal logic, allowing reversals when the aircraft are vertically within 100 ft. Version 7.1 solves the second problem by replacing AVSA RAs with a "Level Off, Level Off" RA. Independent validations by computer simulations with actual air traffic data from several European sources, Boston and New York have demonstrated safe and effective software performance.[2]

A Eurocontrol recommendation in July 2008 urged the industry to aggressively pursue this software upgrade when revised U.S. and European technical standard orders (TSOs) for TCAS II take effect. "As TCAS II Version 7.1 provides further significant reduction in the risk of midair collisions, it is therefore strongly recommended that TCAS II Version 7.1 is implemented as rapidly as possible," Eurocontrol said.[3]

The organization's policy position is that until all current TCAS II–equipped aircraft and new aircraft are Version 7.1 compliant, there will be no short-term reduction in the unacceptable risk of midair collisions to the Version 7.0–compliant aircraft in Europe, a risk equivalent to one midair collision every three years. Forward fit plus retrofit delayed not more than two years would reduce this risk by a factor of four (*ASW,* 10/08, p. 53), Eurocontrol said.[4] Some European specialists say that no hardware modifications should be necessary, and they have proposed that International Civil Aviation Organization (ICAO) standards require TCAS II Version 7.1 equipage by Nov. 30, 2010, for new aircraft and by March 31, 2013, for existing aircraft.[5]

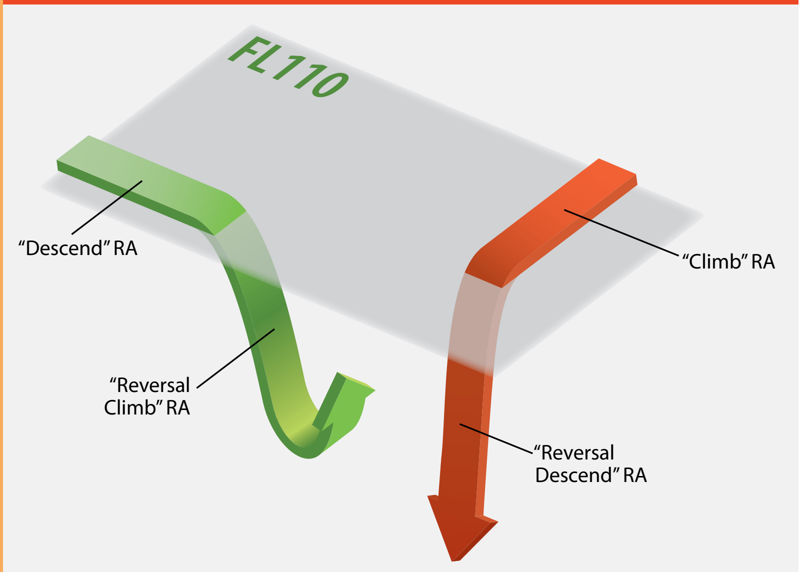
In December 2008, John Marksteiner, the U.S. Federal Aviation Administration (FAA) representative to an ICAO aeronautical surveillance working group, said that it would be premature for ICAO to consider a timeline for mandatory worldwide carriage of TCAS II Version 7.1 without further study.[6] He cited several issues as still unresolved, including different risk levels in the United States and Europe, possibly time needed for manufacturers to develop new equipment and retrofit packages, and an unknown scope of hardware upgrades.

He raised other questions to consider. Will standard cost-benefit analyses show that requiring Version 7.1 retrofit is justifiable instead of clarifying the meaning of AVSA RAs and improving pilot compliance with Version 7.0 RAs through training? How effectively could midair collision risk be mitigated without Version 7.1 compliance by training pilots to climb and descend at less than 1,500 fpm in the last 1,000 ft before level-off at the assigned altitude/flight level? Would analysis of RAs, based on pilot reports and monitoring of downlinked Mode S RA data, enable civil aviation authorities to identify "RA hot spots" in their airspace and mitigate the Version 7.0 shortcomings — with procedural changes, for example?

After TSO revisions for the Version 6.04a-to-Version 7.0 logic upgrade were issued in 1999, the European Joint Aviation Authorities in January 2000 mandated TCAS II Version 7.0 carriage by all civil turbine-engine aircraft with more than 30 passenger seats or maximum takeoff mass of more than 15,000 kg (33,070 lb). U.S. Federal Aviation Regulations (FARs) for these aircraft currently require Version 7.0 or equivalent logic but allow version 6.04A Enhanced if that logic was installed before May 1, 2003, and can be repaired to conform to its original minimum operational performance standards.[7]

U.S. and European TSO revisions expected during 2009 will establish the dates when newly identified or manufactured TCAS II equipment must be Version 7.1 compliant. Steve Plummer, designated federal official representing the FAA at the March 12 meeting of RTCA Special Committee 147 (SC-147), offered no details but said that the FAA is now evaluating what the appropriate strategy should be for implementing Version 7.1, working on harmonizing rule-making strategy with the European Aviation Safety Agency (EASA) and, like others, proposing Version 7.1–related

**TCAS II Version 7.1 Solution to Pilot Error**




TCAS = traffic alert and collision avoidance system; RA = resolution advisory; FL = flight level

**Note**: Current TCAS II logic allows only one climb/descend sense reversal, and reversing an ongoing RA is not permitted while the aircraft are maneuvering within a vertical distance of 100 ft of each other. The illustrated enhancement in the new Version 7.1 logic is that if the aircraft with the red flight path descends contrary to a "Climb" RA, immediate reversal RAs will be generated for pilots of both aircraft.

Source: Eurocontrol Safety Issue Rectification Extension Plus Project

**Figure 1**

language for ICAO standards and recommended practices. The RTCA meeting included representatives of its counterpart on TCAS II standards, the European Organisation for Civil Aviation Equipment (EUROCAE) Working Group 75 (WG-75).

## Last-Minute Modification

The TCAS II Version 7.1 revision to minimum operational performance standards was published by RTCA as RTCA/DO-185B in June 2008 and by EUROCAE as Document ED-143 in September 2008. A post-revision validation process led to a delay in completing the TSOs, however, when a minor discrepancy came to light between the pseudocode[8] and state charts.[9] In one multi-aircraft scenario — that is, involving more than two aircraft — run on a standard computer simulation program, the RAs did not agree. This led to more development, testing, multi-site verification and validation of modifications issued as Change 1 to this standard.

Change 1 eliminates the corrective green arc in TCAS II display symbology for a weakening RA for the aircraft in the middle of a multi-aircraft encounter, according to an SC-147 working group report presented by Andrew Zeitlin of The MITRE Corp. Center for Advanced Aviation Systems. Validations by Eurocontrol and Massachusetts Institute of Technology (MIT) Lincoln Laboratory confirmed that the modifications were safe and effective, Zeitlin said.

On April 21, SC-147 is scheduled to approve Change 1 to RTCA/DO-185B. Probably later in the second quarter, the RTCA Program Management Committee is expected to approve this change, in turn enabling the FAA to issue TSO C119c, "Traffic Alert and Collision Avoidance System (TCAS II) Airborne Equipment, TCAS II With Optional Hybrid Surveillance." Parallel work in Europe included EASA's March 12 issuance of Notice of Proposed Amendment No. 2009-03 similarly updating European Technical Standard Order ETSO-C119b.

## FAA Monitors RAs

The FAA has been deploying monitoring systems at 20 U.S. sites that collect data on TCAS RAs for analysis of both safety and air traffic management. As of March, the systems were operational in Boston, Los Angeles, New York and Philadelphia, said Neal Suchy, the FAA's TCAS program manager during Version 7.1 development.

This FAA analysis first has focused on business jets operating below Class B airspace and RAs occurring during multi-aircraft encounters, he said. Three more California sites — Ontario, Long Beach and Oakland — are scheduled to be deployed by the end of May, and the FAA also expects to monitor TCAS II performance near Louisville, Kentucky, using automatic dependent surveillance-broadcast technology in the nation's first Next Generation Air Transportation System (NextGen) environment.

During development of Version 7.1, Eurocontrol contractors used TCAS II computer simulations to validate the performance of the AVSA RA–related enhancements. They first were compared with Version 7.0 using aircraft encounter data from Europe. The effort comprised safety aspects, human factors aspects and operational aspects.

After reviewing the European results, however, RTCA SC-147 specialists wanted to confirm that AVSA-related enhancements would not disrupt FAA terminal control area operations or induce a conflict with a third-party aircraft flying near a TCAS II-equipped aircraft, given the country's dense mixes of air carrier and general aviation traffic operating under different flight rules. In response, a Eurocontrol analysis identified 92 initial AVSA RAs among a total 992 RA encounters from Boston-area data recorded by MIT Lincoln Laboratory, with 81 AVSA RAs suitable for detailed study.

These RAs occurred during six months of 2006 within a 60-nm (111-km) radius of Boston Logan International Airport, and the Eurocontrol contractors received both FAA radar data and RAs downlinked by MIT from a Mode S transponder sensor. About half of the recorded AVSA RAs involved two aircraft; the remainder involved three to seven aircraft in the surrounding traffic.

This analysis found that the AVSA-related changes in TCAS II Version 7.1, assuming that all aircraft in the airspace were equipped alike, would generate one "Level-off, Level-off" RA about once every three days in the Boston airspace compared with an average of 18 RAs of all types recorded every three days. The new "Level-off, Level-off" RA did not induce a conflict with any third-party traffic, and the likelihood of such a conflict was deemed "extremely remote."

Eurocontrol contractors next looked at three months of 2007 FAA radar data from recorded aircraft encounters that occurred within a 60-nm radius of John F. Kennedy International Airport. They did not have downlinked Mode S transponder data available from this airspace, so RA data were extrapolated based on an assumption that the aircraft were fitted with TCAS II operating in RA mode as required by current FARs.

## Pilot-Friendly Benefits

Eurocontrol, its research contractors, other European aviation organizations and the FAA expect introduction of the "Level-off, Level-off" RAs in TCAS II Version 7.1 to be welcomed worldwide. The Version 7.0 logic had been designed with an expectation that pilots of converging aircraft would become comfortable ensuring initial separation solely by simultaneously modifying their present climb/descent rates rather than climbing, descending or leveling off. In such scenarios, however, today's TCAS II may direct one flight crew to reduce climb rate from, say, 2,500 fpm to 1,000 fpm in about three seconds, Eurocontrol noted. Unlike that scenario, intuitively simple "Level-off, Level-off" RAs will be of shorter duration and typically involve less altitude change.[10]

"In the same geometries, the Version 7.0 logic can post increasingly stronger AVSA RAs, possibly up to a positive RA, in quick succession if the vertical convergence rate is not decreasing as fast as expected, which constitutes a complex RA sequence," said the Eurocontrol report on New York airspace simulations. "With [Version 7.1 logic], this complex sequence can be replaced by a single Level-off RA, as it is more efficient in rapidly reducing the vertical convergence."

For ATC, one of the main safety benefits of Version 7.1 will be that pilots receiving RAs will not continue in the same vertical direction, Eurocontrol said. A conclusion from its analysis of Boston data was that "TCAS II Version 7.0 issued RAs that left both aircraft evolving in the same vertical direction and, despite appropriate pilot responses, the target vertical separation of 350 ft was not achieved at their closest approach."

### Notes

1. Arino, Thierry; Chabert, Stéphan; Drévillon, Hérve. "Decision Criteria for Regulatory Measures on TCAS II Version 7.1." Eurocontrol Mode S Programme, DSNA and Egis Avia Safety Issue Rectification Extension Plus (SIRE+) Project. July 17, 2008.
2. Arino; Drévillon. "Operational Performance of CP115 in New York Airspace." Dec. 4, 2007.
3. Arino; Chabert; Drévillon.
4. Eurocontrol. "TCAS II Version 7.1." <www.eurocontrol.int/msa/public/standard_page/ACAS_Upcoming_Changes.html>.
5. Loscos, Jean-Marc; Mallwitz, Roland; Potier, Eric; Woods, Ray. "Update to ACAS Mandatory Carriage." An ICAO working paper presented in Montreal to the Aeronautical Surveillance Panel Working Group of the Whole. Document ASP-WGW/1-WP/12. Nov. 24, 2008.
6. Marksteiner, John. "ACAS Carriage Considerations." An ICAO working paper presented in Montreal to the Aeronautical Surveillance Panel Working Group of the Whole. Document ASP-WGW/1-WP/17. Dec. 5, 2008.
7. Eurocontrol ACAS [Airborne Collision Avoidance System] Programme; Sofréavia; CENA. "European Maintenance of TCAS II Version 7.0: Project EMOTION-7 Final Report." Report no. ACAS/03-003. January 2003.
8. *Pseudocode* is an informal structured language that programmers use to convey to other people high-level descriptions of computer programming algorithms.
9. *State charts* in RTCA/DO-185B are tables showing a transition, code location, trigger event, true/false status of conditions and output action in the collision avoidance system logic.
10. Arino; Drévillon. "Operational Performance of CP115 in Boston Airspace." March 9, 2007.

# Back to the Drawing Board

**The FAA wants sweeping changes to airline crewmember and dispatcher training.**

BY PATRICK CHILES

Fundamental changes to how commercial airlines conduct their flight crew, flight attendant and dispatcher training programs have been proposed by the U.S. Federal Aviation Administration (FAA) based on input by an industry/government working group.[1] If the changes are adopted, U.S. air carriers will have five years to bring their respective programs into compliance.

Many carriers may find that they are already partway there. The proposed rule making has been in development since 2004, when an Aviation Rulemaking Committee (ARC) was formed specifically to address changes to Subparts N and O — respectively, *Training Programs* and *Crewmember Qualifications* — of U.S. Federal Aviation Regulations Part 121. Composed of representatives from airlines, manufacturers, training organizations and professional organizations, the ARC produced a final product that describes training philosophies that presently are considered "best practices." Some highlights include:

- Line-oriented flight training (LOFT) conducted in full-motion simulators;
- Special training in hazards such as controlled flight into terrain;
- Additional practical training in crew resource management (CRM), integrated with dispatch resource management (DRM);
- Nine-month cycle of recurrent pilot training replacing the current six- and 12-month cycles;
- Special training for specific qualifications or equipment such as reduced vertical separation minimum, extended operations and automatic external defibrillators;
- Annual hands-on emergency equipment drills for flight attendants;

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- Supervised operating experience (SOE) for dispatchers, similar to flight crew initial operating experience (IOE);
- Requalification training for flight crewmembers and dispatchers; and,
- Uniform terminology applied to all training programs and associated manuals.

The FAA wants to reorganize qualification and training requirements across the board. The U.S. National Transportation Safety Board (NTSB) has identified inadequate training as the probable cause of 169 accidents over the 20 years preceding the ARC's formation. The desired effect of the proposed regulations is to reduce the likelihood of human error leading to an accident.

## New Performance Standards

The proposed rule making is wide-ranging, and carriers must evaluate the impact on their programs of all the proposed changes. However, the following changes are significant.

Probably the most fundamental change is the concept of qualification performance standards (QPS), which would become new appendixes to Part 121. They are meant to be uniform, objective performance standards that can be updated routinely as the operating environment dictates. In addition to setting minimum standards for training and evaluation, QPS would drive procedures for the qualification of crewmembers and dispatchers. Much of this will be familiar, as the standards are based on existing content in Subparts N, O and P (*Aircraft Dispatcher Qualification and Duty Time*), all of which would be replaced. Each QPS appendix would be composed of a regulatory "Requirements" section and an advisory "Information" section.

Unlike other regulations, QPS standards have been designed to be responsive and flexible. The authority for issuing revisions would be delegated from the FAA administrator to the director of flight standards. This alteration of the normal rule-making review process would allow timely adjustments addressing such things as accident trends and technological advances. Affected carriers should consider this carefully; while rapid response to the environment is welcome, it simultaneously leaves the door open for surprises.

## Simulation Required

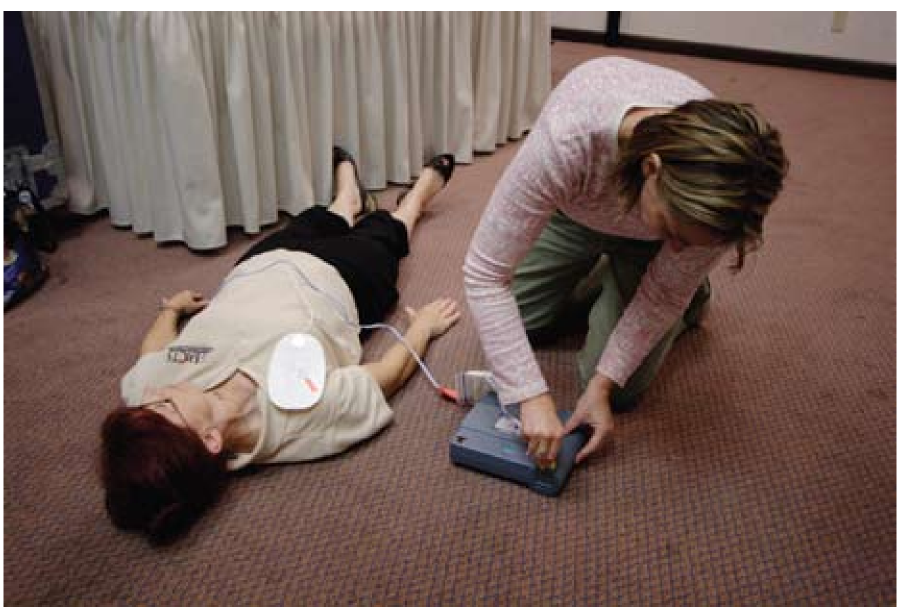
All flight crewmember training would have to be conducted in approved flight simulator training devices, which currently are *required* only for wind shear training. The benefits of training for critical tasks such as rejected/continued takeoffs in a benign environment, rather than in an airplane, are obvious. However, carriers might be able to request deviations on a limited basis. The FAA admits that flight simulators might not be immediately available for critical-task training or for some older aircraft.

There is a driving focus on keeping training programs closely aligned with the daily operating environment. To this end, flight crew recurrent training would have to include a full cockpit crew performing their actual duties in a typical flight environment. Otherwise known as LOFT, this is already common practice.

## 'Full-Featured' Manuals

Proposed requirements for flight crew operating manual (FCOM) content have the apparent goal of making the manual a sole-source document. What was once a basic aircraft operating manual would become a "thorough and accurate compilation" of required operating tasks that typically are found in a carrier's general operations manual. Carriers need to carefully consider how they would meet these requirements. Incorporating procedures that typically occupy dedicated manuals in each model's FCOM could be a daunting task, to say the least. If not done judiciously, the operating manuals

Among the proposed changes to U.S. airline crew training is periodic instruction in the use of lifesaving equipment such as automatic external defibrillators.



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could become cumbersome to the point of being ineffective.

Another proposed requirement driven by NTSB recommendations is the integration of CRM/DRM into a "team management" concept encompassing team interaction and decision making, information management and problem solving. For example, LOFT will evaluate CRM in addition to each crewmember's performance, and DRM will be evaluated during dispatcher proficiency checks. Similarly, flight attendant performance drills will include CRM proficiencies.

## Dispatcher Qualifications

Reflecting a longstanding need to codify industry practices and FAA policies, the proposed rule contains the new positions of dispatch instructors and check dispatchers, curriculum standards and SOE. There also is an interesting allowance for a carrier to combine a new dispatcher licensing course with its initial-training curriculum.

Dispatch instructors would have to hold an aircraft dispatcher certificate, maintain currency and meet specific instructor training requirements. An exception would be made for subject matter experts who provide instruction on specific FAA-approved topics — for example, a meteorologist might be allowed to teach weather.

Check dispatchers — currently called "supervisors" or "ground instructors" — would have to meet similar requirements in addition to new "recency of experience" standards. This would correct a present flaw that could allow a dispatcher with no recent work experience to perform competency checks.

SOE, like pilot IOE, would ensure that a dispatcher is thoroughly familiar with his or her company's operating practices and has the opportunity to demonstrate practical knowledge under direct supervision in the actual work environment. It likewise would set specific criteria for those overseeing dispatchers undergoing SOE, including assignment of only one student at a time.

The common-sense intent here is to ensure that dispatch instructors are current and knowledgeable in the carrier's specific procedures, equipment and facilities. However, this could impact some third-party training vendors: A "generic" program, possibly taught by otherwise well-qualified individuals without dispatcher licenses, may no longer be acceptable.

## Flight Attendants

As with dispatchers, flight attendant training and instructor standards would become much more specific. Standards for eligibility, qualifications and approval would be codified for instructors and check flight attendants.

Significantly, flight attendants would have to complete operating experience in the specific aircraft types to which they are assigned. Currently, they must complete IOE on one aircraft "group" — for example, propeller-driven or turbojet — appropriate to their company.

Flight attendants also would have to accomplish emergency equipment drills every 12 months, instead of the current 24 months. This would ensure recent practice with critical equipment in potential lifesaving situations and is responsive to both NTSB and International Civil Aviation Organization recommendations.

## Continuous Analysis

Carriers also would have to implement a continuous analysis program similar to those already in effect for maintenance and inspection. Each airline would have to create procedures to maintain and validate both their training program and the continuous analysis process itself. They also would have to analyze crew and dispatcher evaluations to determine if any weaknesses exist, and revise their training programs to address the weaknesses.

In its full context, these are sweeping changes and a clear response by the FAA to some diverse trends in aircraft accidents that NTSB has clearly laid at the feet of training programs. With such things as incomplete manuals, inadequate procedures and poor CRM identified as contributing to so many accidents, the time is ripe.

The proposed rules are open for public comment until May 12. A public meeting was scheduled to be held early in April at the NTSB Training Center in Ashburn, Virginia, to give affected parties an opportunity to pose questions directly to the FAA before submitting their comments on the proposed rule.

While many carriers may be relieved to find that their programs are already well along the road to compliance with the proposed requirements, the proposed rule would bring fundamental changes to how U.S. airlines conduct training and evaluation. So many carriers utilize full-motion simulators and LOFT that it hardly seems like a stretch for those to now be required. But many smaller airlines and niche carriers with unusual equipment might have to rethink their programs.

*Patrick Chiles is manager of technical operations for the NetJets Large Aircraft program. He is a member of the Flight Safety Foundation Corporate Advisory Committee and the Society of Aircraft Performance and Operations Engineers.*

## Note


1. FAA. *Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers; Proposed Rule*. Docket no. FAA-2008-0677. January 2007. <http://edocket.access.gpo.gov/2009/pdf/E8-29584.pdf>.

# Making a List

**Published lists of air carriers and civil aviation authorities that are up to par — and those that fall short — are playing an increasingly influential role in aviation safety.**

BY LINDA WERFELMAN

In October 2005, spurred by a trio of deadly air carrier accidents[1] two months earlier, the European Parliament voted to create a blacklist of unsafe airlines and to ban those on the list from operating in Europe.

More than three years later, in its ninth revision — at press time, the 10th revision was due to be released soon — the blacklist has become, along with safety assessments conducted by the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO) and the U.S. Federal Aviation Administration (FAA), a major tool for evaluating aviation safety.

The various evaluation tools work together in ways that had not been anticipated, said William R. Voss, president and CEO of Flight Safety Foundation.

"There's a synergy that's developed among all of these efforts that's putting pressure on countries throughout the world to improve aviation safety," Voss said. "The interaction is creating a different tone in the industry. In the long run, that's very beneficial."

Antonio Tajani, European Commission vice president in charge of transport, said that the EU blacklist "is essentially a tool that ensures safer skies in Europe. Through this list, Europeans and non-Europeans alike flying in Europe know that there exists a certain degree of safety on which they can rest assured."[2]

Nevertheless, some skepticism remains, said Nicholas A. Sabatini, retired FAA associate administrator for aviation safety and now an aviation safety consultant.

"I don't believe in blacklists," Sabatini said, adding that they may nevertheless serve a useful purpose on a temporary basis, in the absence of other evaluation tools. "What I don't like is that you don't know what the criteria are."

The Foundation initially opposed the creation of blacklists, but Voss said it is difficult to argue against the listing of airlines that have been involved in numerous accidents in a short period. "It's hard to say that their placement on a blacklist isn't warranted," he said.

"The blacklist has had a pretty strong effect. It got a lot of people's attention, and amplified the impact of some of the other safety evaluation programs."

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Left: An Antonov An-2 sees action with Thom's Airways in the Democratic Republic of Congo as a "bush taxi," painted with the livery of a local beer company. Right: Lion Air is an Indonesian budget airline whose fleet includes this McDonnell Douglas MD-82.

The November 2008 blacklist names 169 airlines, including all air carriers certified by civil aviation authorities (CAAs) in Angola, Democratic Republic of Congo, Equatorial Guinea, Indonesia, the Kyrgyz Republic, Liberia, Gabon, Sierra Leone and Swaziland. The blacklist also names four airlines whose operations within the EU are subject to restrictions.

Airlines are placed on the blacklist if they are found deficient in safety criteria that "relate essentially to the findings of SAFA [Safety Assessment of Foreign Aircraft] inspections carried out at European airports, the use of badly maintained, antiquated or obsolete aircraft, the inability of the airlines involved to remedy any identified shortcomings and the inability of the authority responsible for overseeing an operator to perform this task," the EU said.[3] Updates of the list are published on the EU Web site and posted in European airports.

The objective of the blacklist is not only to identify safety issues but also to resolve them, said Fabio Pirotta, European Commission spokesperson for transport.

"It should be seen as a complementary tool to other initiatives aimed at keeping Europe's skies safe," Pirotta said. "A case in point is the work undertaken by the European Aviation Safety Agency (EASA), whose primary role is that of a controller of the work of the national CAAs in order to verify whether EC law is correctly applied in member states.

"EASA also collects information on compliance of aircraft and their operation with … ICAO safety rules and standards on the basis of inspections of aircraft carried out at EC airports, and on accidents and incidents reported by a member state. In this way, the agency can identify risks and contribute to [the enhancement of] air safety."

## Airline Audits

About two years before the first publication of the EU blacklist, IATA established its Operational Safety Audit (IOSA) program, designed to evaluate airline operational management and control systems.

In that time, the IOSA program has conducted more than 700 audits and listed more than 300 airlines on the IOSA Registry. Beginning in 2008, listing on the IOSA Registry became a requirement for membership in IATA, and about 20 operators have been removed or have voluntarily withdrawn from membership for failing to meet IOSA standards or, in some cases, failing to undergo an audit.

"There have been cases where airlines have elected to abandon their initial audit to undergo a new audit being better prepared," said IATA Corporate Communications Specialist Martine Ohayon.

She said that IATA works with the EC to harmonize the differing perspectives of their two programs: "The EC blacklist is driven more by the results of ramp inspection programs (where an individual airline is concerned) or because of concerns about state oversight capability. … IOSA is a fundamental examination of an airline's operational safety practices conducted


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An extravagantly painted Airbus A320-232 is flown by Siem Reap Air, based in Cambodia.

largely at the airline headquarters. Each program is looking at different things."

## Evaluating CAAs

Rather than focusing on airlines, the FAA International Aviation Safety Assessment (IASA) Program, established in 1992, aims to improve aviation safety by evaluating the CAAs of countries with air carriers that operate — or are seeking authority to operate — in the United States. The evaluations result in issuance of one of two ratings: Category 1 for those that comply with ICAO standards and Category 2 for those that do not.

At press time, 79 countries were rated Category 1; 22 had received Category 2 ratings.

The FAA says that Category 2 ratings are applied "if one or more of the following deficiencies are identified:[4]

- "The country lacks laws or regulations necessary to support the certification and oversight of air carriers in accordance with minimum international standards;
- "The CAA lacks the technical expertise, resources and organization to license or oversee air carrier operations;
- "The CAA does not have adequately trained and qualified technical personnel;
- "The CAA does not provide adequate inspector guidance to ensure enforcement of, and compliance with, minimum international standards; and,
- "The CAA has insufficient documentation and records of certification and inadequate continuing oversight and surveillance of air carrier operations."

If a country receives a Category 2 rating, its air carriers may continue any existing operations in the United States but may not expand service as long as the Category 2 rating remains in effect.

"It is up to the CAA in that country to remedy the findings and ask for a reassessment when the CAA is ready," said FAA spokeswoman Alison Duquette. "The whole idea is that they work to improve on what we found. Some CAAs can do this rather quickly and some cannot, depending on many economic and political factors in that country."

The detailed criteria inherent in IASA and in ICAO's Universal Safety Oversight Audit Programme (USOAP) provide "the value and the power" of such programs, said Sabatini, who recalled the creation of IASA, in the aftermath of the Jan. 25, 1990, crash of an Avianca Boeing 707 in Cove Neck, New York, U.S. The airplane ran out of fuel after repeatedly being placed in weather-related holding patterns toward the end of a flight from Bogotá, Colombia, to New York. Seventy-three of the 158 people in the airplane were killed.[5]

"Before that, no one assessed other member states to determine their compliance with ICAO Annexes 1, 6 and 8 [dealing with personnel licensing, aircraft operation and airworthiness], the results of which would indicate the effectiveness of their oversight of their air carriers," he said.

## ICAO Audits

Like IASA, USOAP audits ICAO member states, not airlines, to determine how effectively they have implemented aviation safety oversight systems and the status of their implementation of a specific set of ICAO's safety-related standards and recommended practices.

A USOAP audit focuses on the same categories evaluated by IASA: the country's primary aviation legislation; specific operating regulations; state civil aviation system and safety oversight functions; technical personnel qualification and training; technical guidance, tools and provision of safety critical information; licensing, certification, authorization and approval obligations; surveillance obligations; and resolution of safety concerns.[6]

The mandatory program, which began in 1999, conducts about 40 audits every year — a pace that requires each member state to host a USOAP audit at least once every six years.

In 2006, ICAO pressed its member states for consent to allow the posting of at least portions of their USOAP audits in the Flight Safety Information Exchange on the ICAO Web site.[7] By the end of 2008, audit results comprising at least a one-page chart from 161 of 190 member states had been posted. Unlike IASA, USOAP does not assign a rating to supplement the posted information.

USOAP audits currently are in their second cycle, which will end in December 2010, when they will be replaced by a new review program involving the continuous monitoring of CAA actions.

"The concept of continuous monitoring is based on the establishment of a system that will continuously monitor the safety oversight capabilities of contracting states and ensure that states develop, maintain and apply national regulations that conform to the ICAO standards and recommended practices," said Roberto Kobeh González, president of the ICAO Council. "It incorporates the principles of safety management, focusing on a systematic identification of deficiencies in the state safety oversight capability, assessment of associated safety risks and implementation of strategies to rectify deficiencies and mitigate risks."[8]

CAA reviews conducted under USOAP and IASA are vital, Voss said.

"It's not enough to have a beautiful airline with a sparkling reputation," he said. "The CAA oversight has to be just as good."

### Notes

1. The August 2005 accidents involved a Helios Airways Boeing 737-300, a West Caribbean McDonnell Douglas MD-82 and a TANS Peru Airlines 737-200. The Helios 737 crashed near Grammatikos, Greece, on Aug. 14, killing all 121 passengers and crew. The final report on the accident said that the flight crew failed to notice that the airplane's pressurization mode selector had remained in the manual position after maintenance the night before the flight. They — and everyone else in the airplane — were incapacitated by hypoxia, and the airplane crashed after its fuel supply was exhausted. On Aug. 16, the MD-82 crashed into a swamp near Machiques, Venezuela, killing all 160 passengers — most of them from the French Caribbean island of Martinique — and crew. Reports said that the crew of the charter flight lost control of the airplane after both engines flamed out. On Aug. 25, the TANS 737 crashed in a hailstorm during a visual approach in Pucallpa, Peru. Forty-five of 98 people in the airplane were killed, and 55 were injured. Peruvian investigators said the probable cause of the accident was the decision to continue the approach and landing in severe weather conditions.
2. Europa. *Airlines Banned From European Skies: Commission Updates Its Blacklist*. Nov. 14, 2008. <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1707&format=HTML&aged=0&language=EN&guiLanguage=en>.
3. Europa. *Rapid Agreement Reached on Airline Blacklist*. Nov. 16, 2005. <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/05/1429&format=HTML&aged=0&language=EN&guiLanguage=en>.
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5. U.S. National Transportation Safety Board (NTSB). *Aircraft Accident Report: Avianca, The Airline of Colombia, Boeing 707-321B, HK 2016, Fuel Exhaustion, Cove Neck, New York, January 25, 1990.* NTSB/AAR-91/04. April 30, 1991. The NTSB said the probable cause of the accident was the flight crew's "failure … to adequately manage the airplane's fuel load, and their failure to communicate an emergency fuel situation to air traffic control before fuel exhaustion occurred."
6. ICAO. *Universal Safety Oversight Audit Programme (USOAP)*. <www2.icao.int/en/ssa/soa/usoap/Pages/default.aspx>.
7. The Internet address is <www.icao.int/fsix/auditrep1.cfm>.
8. Kobeh González, Roberto. Speech to the 45th Conference of Directors General of Civil Aviation of the Asia and Pacific Regions, Kuala Lumpur, Malaysia. Nov. 24, 2008.

### Further Reading From FSF Publications

Rosenkrans, Wayne. "Inspector Scrutiny." *AeroSafety World* Volume 2 (August 2007): 30–35.

Rosenkrans, Wayne. "Leading a Quest for Transparency." *AeroSafety World* Volume 2 (February 2007): 39–41.


The state-owned national airline of Angola uses the Boeing 777-200ER for long-haul operations.

# Every Trip Has a Story

BY MARK LACAGNINA

**Resetting a circuit breaker without knowing why it opened can be deadly.**

*Circuit Breakers — In*. Most general aviation pilots react to that ubiquitous preflight checklist item by hunting down any open circuit breakers (CBs) and dutifully pushing them back in. Similarly, there is the old saw about a CB that trips in flight: Reset it once; if it trips again, leave it alone.

These are dangerous habits, according to the U.S. National Transportation Safety Board (NTSB), which has pointed to a recent in-flight fire and fatal crash in calling for education and training of general aviation pilots and maintenance personnel on the hazards of resetting CBs without knowing why they tripped. The crash also exemplifies the potential consequences of not following required procedures when maintenance is deferred and of operating an aircraft with a known discrepancy, according to the board's final report on the accident.[1]

The accident occurred the morning of July 10, 2007, and involved a Cessna 310R — one of nine airplanes operated by the National Association for Stock Car Auto Racing (NASCAR). The company used the light piston twin primarily to transport equipment and documents but occasionally allowed its medical officer to conduct personal flights in the airplane with a company pilot aboard as a safety pilot.

The medical officer, 53, held a commercial pilot certificate and had 276 flight hours, including 26 hours in the 310. He was the pilot-in-command (PIC) of the accident flight. The safety pilot, 56, held an airline transport pilot certificate with several type ratings and had 10,580 flight hours, including 67 hours in the 310. Both pilots had completed 310 proficiency training at a commercial flight-training facility in January 2007.

## Smoke in the Cockpit

The airplane departed from Daytona Beach, Florida, at 0822 local time for a flight to Lakeland, about 80 nm (148 km) southwest. Shortly after the 310 reached its cruise altitude, 6,000 ft, the safety pilot declared an emergency and told air traffic control (ATC) that there

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was smoke in the cockpit and that they were diverting to Sanford International Airport.

ATC radio contact and radar contact with the airplane were lost when it was about 8 nm (15 km) northwest of the airport and descending rapidly. Witnesses saw the 310 trailing smoke as it made a steep turn to the west shortly before striking trees and crashing in a residential area. The pilots and three people on the ground were killed, and four people on the ground were seriously injured. The airplane and two houses were destroyed by the impact and postcrash fire.

Examination of the wreckage revealed signs of an in-flight fire. Thermal damage and soot deposits were found on components that came to rest outside the area of the postcrash fire. The cabin door, for example, was found relatively intact about 60 ft (18 m) from the main wreckage. "The undamaged latching pins and the location and existence of the observed trailing soot deposit are consistent with the pilots having opened the cabin door to vent smoke during an in-flight fire," the report said.

Most of the recovered electrical system components and wiring were severely damaged or destroyed. However, markings on some wiring indicated that it had polyvinyl chloride (PVC) insulation, which produces toxic hydrogen chloride gas when heated. "PVC-insulated wiring has not been used as a general-purpose wire in new airplane designs by Cessna and other manufacturers since the early 1970s," the report said. "However, the FAA [U.S. Federal Aviation Administration] permitted the continued use of PVC-insulated wiring in airplanes in which it was already being installed, including Cessna 310s, which Cessna had been manufacturing since 1953."


Christine Lacagnina

Collaring a CB with a tie wrap helps to prevent a defective electrical component from being reactivated.

## 'Don't Turn It On'

Investigators also found a maintenance discrepancy report that had been filed by another company pilot who flew the 310 the day before the accident. The discrepancy report said that the pilot smelled electrical components burning shortly after the weather radar display "went blank" during cruise flight and that the odor ceased after he turned off the unit and pulled its 5-ampere CB. The pilot left one copy of the discrepancy report in the maintenance binder, which he placed on the airplane's throttle quadrant, and gave the other copy to the director of maintenance.

The accident report said that an in-flight fire could have occurred during the previous day's flight if the pilot had not pulled the CB: "Pulling the circuit breaker for the weather radar stopped a symptom — the burning smell — of the problem by removing electrical power from the circuit. However, it did not correct the underlying problem."

NASCAR's aviation department did not have documented guidance for scheduling and tracking airplane maintenance, or for communicating the maintenance status of its airplanes to maintenance technicians and pilots. "Further, NASCAR had no system through which any individual, including the director of maintenance, could remove an airplane from the flight schedule because of airworthiness concerns," the report said.[2]

The weather radar maintenance discrepancy report was discussed by the aviation director, chief pilot and director of maintenance, who agreed that the 310 could be flown the next day. "According to the chief pilot, the director of maintenance told him: 'It will be okay. Just tell [the safety pilot] not to turn it on,'" the report said.

## Not Airworthy

The reported maintenance discrepancy was not investigated before the accident flight, no corrective maintenance was performed, and none of the required actions for continued operation of the 310 were taken. "Without examining the weather radar system and then either removing the airplane from service or placarding the airplane and collaring the circuit breaker, as well as making a maintenance records entry, it was not permissible to fly the airplane under federal regulations," the report said. A CB is "collared" with a tie wrap or similar device to prevent it from being reset.

Both pilots had access to information that would have alerted them to the unresolved maintenance discrepancy and the hazard that it presented, the report said. The safety pilot had been told about the weather radar discrepancy during a telephone call from the chief pilot and during a conversation with a maintenance technician. "On both occasions, the [safety pilot] dismissed the issue as unimportant," the report said. The safety pilot's reaction likely was based on the perception that the weather radar system would not be needed because visual meteorological conditions prevailed along the planned route.

Apparently, no one told the PIC about the maintenance discrepancy; but the write-up by the pilot who had flown the airplane the previous day was available for review. "The maintenance discrepancy binder was prominently placed on the throttle quadrant and would have been easy to review during the preflight inspection or before the airplane departed," the report said.

## Routine Reset

The 310 had been flown without further event for about an hour after the pilot pulled the weather radar CB the previous day. The next day, the airplane had been aloft about 10 minutes when the safety pilot declared an emergency, and it crashed two minutes later. Examination of the wreckage indicated that the in-flight fire likely began in the left cockpit sidewall, which houses a dense collection of electrical wiring for various components as well as fuel lines for gauges in the instrument panel.

"The most likely reason for the rapid onset of the problem is that one of the pilots reset the radar circuit breaker, thus reinitiating the development of the problem encountered on the previous flight," the report said.

A firm conclusion could not be made, but it is likely that the CB was reset by the PIC. The CB panel was near the PIC's left leg and would have been difficult for the safety pilot to reach.

"General aviation pilots often reset circuit breakers during preflight preparations unless the circuit breakers are placarded or collared to show that the associated system is to remain unpowered," the report said, noting that the 310's "Before Starting Engines" checklist included the item: "Circuit Breakers — In."

The report also cited potentially hazardous guidance in the pilot's operating handbook for the 310 — and in many other general aviation aircraft handbooks — that a tripped CB can be reset *once* after allowing it to cool for a specific period. "The rationale behind this one-time reset practice is that if

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the circuit breaker tripped because of anything other than a transient or nuisance event and if the triggering condition was still present, the circuit breaker would trip again shortly after being reset," the report said.

## Spreading the Word

NTSB's warnings about resetting CBs echoed those in the final report by the Transportation Safety Board of Canada (TSB) on the 1998 crash near Peggy's Cove, Nova Scotia. The TSB report said that resetting even a low-ampere CB can be dangerous, especially if the initiating event is electrical arcing.[3] "A tripped CB should not be reset before any associated fault is located and eliminated," the report said.

The Peggy's Cove accident and others involving in-flight fires prompted the FAA in 2004 to issue Advisory Circular (AC) 120-80, *In-Flight Fires*. The AC says that even if there is no hidden fire that causes a CB to trip, "the resetting of a tripped circuit breaker can overheat wiring, ultimately leading to failure and arcing."

NTSB investigators found signs of an in-flight fire.

Noting that some aircraft electrical components are critical to safe flight and must remain powered, AC 120-80 provides the following guidance about resetting tripped CBs:

> *Crewmembers may create a potentially hazardous situation if they reset a CB without knowing what caused it to trip. A tripped CB should not be reset in flight unless doing so is consistent with explicit procedures specified in the approved operating manual used by the flight crew or unless, in the judgment of the captain, resetting a CB is necessary for the safe completion of the flight.*

In its report on the 310 accident, NTSB said that most air carriers operating under U.S. Federal Aviation Regulations Part 121 have used information from the AC to revise their manuals and checklists to specify CBs that are essential and may be reset. "Moreover, aircraft operated under Part 121 commonly have indicators, such as circuit breaker markings or coloring, or segregated placement of specific circuit breakers in the cockpit, showing which circuit breakers are critical," the report said.

However, many corporate/business aircraft operators and private pilots operating under the general flight rules of Part 91 have not changed their operating procedures. "One reason might be that individuals operating airplanes under Part 91 are less likely to have a formal system for addressing AC guidance," the report said. "As a result, many general aviation pilots, mechanics and operators may not have reviewed AC 120-80. Even if [they] have reviewed the AC, the guidance contained in manuals provided by general aviation airplane manufacturers often directly conflicts with the guidance contained in AC 120-80."

Based on the findings of the 310 accident investigation, NTSB called on the FAA to inform general aviation aircraft operators, pilots and maintenance technicians about the guidance provided by the AC and to require that the information be included in initial and recurrent training. "If general aviation pilots, maintenance personnel and operators had a more thorough understanding of the potential hazards of a reset circuit breaker — as outlined in AC 120-80 — they would be less likely to reset a tripped circuit breaker without knowing what caused that circuit breaker to trip," the report said.

NTSB also recommended that the FAA require general aviation aircraft manufacturers and aftermarket-equipment suppliers to either improve or create guidance "regarding which circuit breakers pilots should and should not attempt to reset before or during flight."

### Notes

1. NTSB Aircraft Accident Summary Report NTSB/AAR-09/01/SUM, *In-Flight Fire, Emergency Descent and Crash in a Residential Area; Cessna 310R, N501N; Sanford, Florida; July 10, 2007*.
2. The report said that NASCAR made many changes after the accident to improve is maintenance policies and procedures.
3. TSB Accident Investigation Report A98H0003, *In-Flight Fire Leading to Collision with Water: Swissair Transport Limited; McDonnell Douglas MD-11, HB-IWF; Peggy's Cove, Nova Scotia, 5 nm SW, 2 September 1998*.

# Tanzania's Runway Game

**Aircraft system/component failure is high on the list of accident and incident causal factors, not to mention zebras on the runway.**

BY RICK DARBY

Africa has the highest rate of fatal accidents in commercial air transport among all International Civil Aviation Organization (ICAO) regions, and the trend has not been improving (Figure 1). The International Air Transport Association (IATA) calculated that in 2005, total hull losses per million departures were 12.9 times the world average.[1] The report from the ICAO conference at which the IATA data were presented said, "Causal factors for the accidents occurring in Africa are generally difficult to identify due to the lack of proper reporting and/or investigation of the occurrences. Often, data on accidents and serious incidents are known from various sources, including the media, but some are not available in the ICAO Accident/Incident Data Reporting (ADREP) system due to lack of compliance by some states with *Annex 13 — Aircraft Accident and Incident Investigation*."

Although Tanzania is not a proxy for all of Africa, data published recently about causal factors of that country's aviation accidents and incidents offer some insight into safety issues in sub-Saharan states.[2] They show that when the ICAO/Commercial Aviation Safety Team (ICAO/CAST) aviation occurrence categories were applied to Tanzanian aviation accident and incident data for the 1997–April 13, 2006, period, the most frequent causal factor was "system/component failure or malfunction, non-powerplant" (Figure 2).

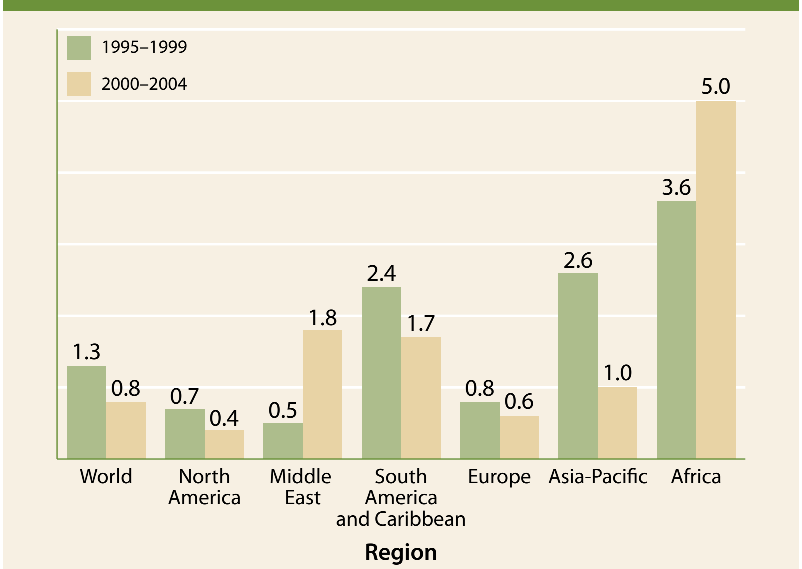
Following that, in descending order, were "system/component failure or malfunction, powerplant"; "abnormal runway contact"; "runway incursion, animal"; "undershoot/overshoot"; and "aerodrome."

In accidents involving fatalities between 1997 and April 13, 2006, the ICAO/CAST category that ranked highest in the number of fatalities was "controlled flight into terrain," or CFIT (Figure 3).[3] Following in descending order were "loss of control in flight" and "overload."

The category involving the largest number of injuries was "system/component failure or malfunction, non-powerplant," followed by "undershoot/overshoot."

While pointing out that data on worldwide fatal accidents for large commercial jets and both fatal and nonfatal accidents for all aircraft in Tanzania are not directly comparable, the report said that "some remarkable differences can be seen." It itemized them:

Fatal Accidents per Million Departures, Commercial Air Transport




Source: International Civil Aviation Organization

Figure 1

- "Controlled flight into terrain and loss of control in flight, which are the most frequent causes for accidents in other parts of the world, are not in the top six causes for accidents in Tanzania";
- "Runway excursions and fire or smoke in the aircraft, which are in the top six causes for fatal accidents worldwide, are not in the top six causes for accidents in Tanzania";
- "System component failure, both powerplant and non-powerplant (mainly landing gear failures), are higher on the list of most probable causes for accidents/incidents in Tanzania than they are for the rest of the world"; and,
- "Abnormal runway contact (mostly hard landings and [gear-up] landings), runway incursion by animals that wander across the runway (mostly giraffes, zebras and antelopes), undershoot and overshoot of the runway, and 'aerodrome' (mostly damage to landing gear by potholes, foreign object damage caused by loose stones, ingestion of stones by engines, etc.) are unique for Tanzania compared to the rest of the world."

## Who's Worried?

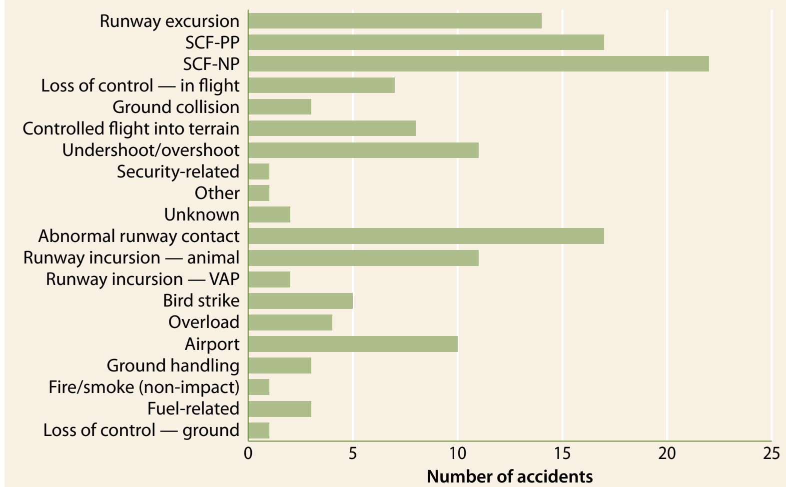
In late 2007, the Australian Civil Aviation Safety Authority (CASA) commissioned the fourth in a series of surveys on the Australian public's perceptions of aviation safety in the country.[4] "The 2008 report shows that the Australian public perceptions … are more positive across a range of measures (confidence in arriving safely, belief in flight safety) than in 2005," the report says.

Slightly more than three-quarters of Australians are "completely" or "very" confident about arriving safely when traveling between state capital cities, with the "completely confident" passengers a higher percentage than in either of the two previous surveys.

The survey found that respondents who had never flown between capital cities were less likely to be completely confident than the experienced population, about 28 percent versus 45 percent. About 6 percent of those who had not flown between capital cities were "very concerned" about arriving safely.

"Levels of confidence and concern are related closely to the recency of flight experience for the individual and whether a person has flown at all,"

**Aviation Accidents and Associated Causal Factors, Tanzania, 1997–April 13, 2006**

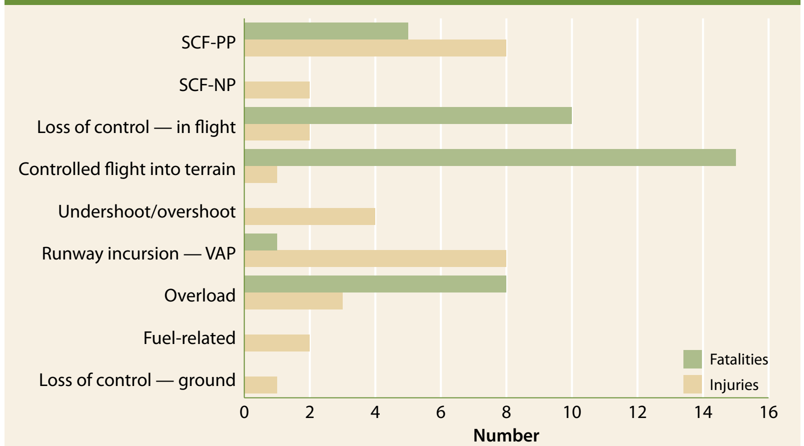



SCF-PP = system/component failure or malfunction (powerplant); SCF-NP = system/component failure or malfunction (non-powerplant); VAP = vehicle, aircraft or person

Source: Hans van Dijkhuizen, for Directorate General of Civil Aviation and Freight Transport, Netherlands

**Figure 2**

**Aviation Fatalities and Injuries and Associated Causal Factors, Tanzania, 1997–April 13, 2006**




SCF-PP = system/component failure or malfunction (powerplant); SCF-NP = system/component failure or malfunction (non-powerplant); VAP = vehicle, aircraft or person

Source: Hans van Dijkhuizen, for Directorate General of Civil Aviation and Freight Transport, Netherlands

**Figure 3**

the report says. Of those who had flown less than a year earlier, 78 percent were either "totally" or "very" confident of arriving safely, compared with 64 percent of those who had never flown. Thirteen percent of those who had never flown were concerned about safety.

Of those who expressed some concern for safety when flying between state capital cities, the most frequently cited reasons were "psychological factors," "mechanical/ technical problem," "terrorism or sabotage" and "human error" (Table 1).

In the last two of those categories, the percentages showed considerable change from earlier surveys. The response "terrorism or sabotage," which had worried 52 percent of those reporting concern in 2005, was reduced to 16 percent in 2008. But 14 percent of the concerned passengers mentioned "human error" in 2008, versus 1 percent in 2005. "CASA may need to consider recent news reports or the regular scheduling of air crash investigation television shows as contributing factors to this increase," the report said.

Some demographic differences were found in the responses (Table 2). Males and high-income travelers were more likely to be confident of arriving safely than those in other groups.

**Australian Public Reasons for Concern About Flying**

| | 2008 (n = 64) | 2005 (n = 79) | 2002 (n = 174) |
|---|---|---|---|
| Psychological factors | 29% | 26% | 42% |
| Mechanical/technical problem | 26% | 16% | 18% |
| Terrorism or sabotage | 16% | 52% | 22% |
| Human error | 14% | 1% | 4% |
| Cost cutting/financial struggles | 3% | — | 2% |
| Due to what I've seen or heard through the media | 2% | — | 1% |
| Fear of crashing/too many accidents | — | 2% | 2% |
| Other | 7% | 2% | 6% |
| Unable to specify a reason for their concern/ cannot say | 3% | 1% | 2% |

**Note:** The survey question specified flying between Australian state capital cities.

Source: Australian Civil Aviation Safety Authority

**Table 1**

**Australian Public Confidence and Concern About Flying, by Demographics**

| | | Sex | | Household Income | | Age of Respondent — Summary | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total (n = 1,526) | Male (n = 753) | Female (n = 773) | < $50,000 (n = 291) | > $50,000 (n = 832) | 18–24 (n = 182) | 25–34 (n = 270) | 35–49 (n = 439) | 50–64 (n = 392) | 65+ (n = 243) |
| Completely confident | 43% | 50% | 37% | 34% | 50% | 42% | 44% | 46% | 41% | 43% |
| Very confident | 35% | 32% | 38% | 41% | 32% | 34% | 34% | 35% | 39% | 31% |
| Reasonably confident | 17% | 14% | 20% | 19% | 15% | 19% | 17% | 16% | 15% | 21% |
| Somewhat concerned | 2% | 2% | 4% | 4% | 1% | 3% | 3% | 2% | 2% | 5% |
| Very concerned | 2% | 1% | 2% | 2% | 1% | 2% | 2% | 1% | 2% | 1% |

**Note:** The survey question specified flying between Australian state capital cities.

Source: Australian Civil Aviation Safety Authority

**Table 2**

## Sources

1. ICAO. "Directors General of Civil Aviation Conference on a Global Strategy for Aviation Safety: The Status of Aviation Safety in Africa." 2006. Available via the Internet at <www.icao.int/icao/en/dgca/wp/dgca_06_wp_18_e.pdf>.

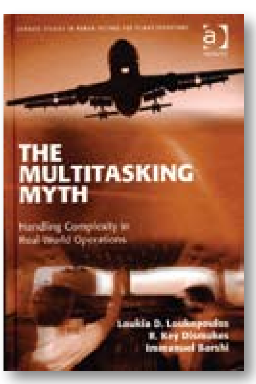
2. Van Dijkhuizen, Hans. *The African Aviation Safety System: Overcoming Bottlenecks With the Implementation of New Technologies.* M.Sc. thesis written at the request of the Directorate General of Civil Aviation and Freight Transport, Netherlands. No date; received at *ASW* in February 2009.

3. Some caveats are noted in the report. Tanzanian data include all aircraft, including jets with less than 60,000 lb (27,216 kg) maximum takeoff weight, helicopters and general aviation aircraft. The author "used his own knowledge and judgment in the classification of causes for fatal accidents." With only seven fatal accidents in the period, involving 39 fatalities and 23 injuries, the data are "extremely sensitive to chance and extreme values (outliers)."

4. *Public Attitudes to Aviation Safety 2008.* Roy Morgan Research, prepared for CASA. June 2008. Available via the Internet at <www.casa.gov.au/media/researchstats.htm>. The main fieldwork was performed in February 2008, with 1,526 telephone interviews of a nationally representative sample of Australians aged 18 and older.

# From Ideal to Real in the Cockpit

**Even the best procedures need to be supplemented by pilot strategies to avoid the perils of interruptions, distractions and the unanticipated.**




**BOOKS**

## Beyond the FOM

**The Multitasking Myth: Handling Complexity in Real-World Operations**

Loukopoulos, Loukia D.; Dismukes, R. Key; Barshi, Immanuel. Farnham, Surrey, England and Burlington, Vermont, U.S.: Ashgate, 2009. 202 pp. Figures, appendixes, references, index.

As far back as Plato, philosophers have debated the ideal versus the real. According to the authors, it is a serious human factors issue today for airline pilots and aviation safety professionals.

As the book's title suggests, one of the most important factors separating the ideal from the real in aviation involves the demands of multitasking — simultaneously doing several things, often while keeping in mind several considerations. Proverbially, we can all walk and chew gum, but in aviation, the tasks are far more complicated and the penalties for failure potentially severe.

What kind of failure? "Performing several tasks concurrently and forgetting to do one of the essential tasks," is one way the authors describe it.

In flying for an airline, they say, the ideal is more or less what is described in the aircraft operating manual and the operator's flight operations manual (FOM). "To perform their jobs in accordance with their employers' operating and safety standards, pilots are required to follow the standardized operating procedures closely, so training is heavily based on FOMs, and rote memorization of the procedures therein," they say. "FOMs implicitly portray cockpit work as having three central characteristics. It is linear, predictable and under the moment-to-moment control of the cockpit crew."

While the procedures in the FOM normally are technically correct and ordered in a logical sequence, actually accomplishing them can require complicated responses. For example, some items "require the pilot to have pre-determined the appropriate response before accomplishing the procedure (e.g., the single procedural items for the fuel system before flight involve checking that two engine valve [lights] and two spar valve lights are illuminated; two filter bypass, one cross-feed valve, and six low pressure lights are extinguished; the cross-feed selector switch is closed; three fuel quantity gauges indicate the expected fuel quantity; and six fuel pumps switches are in the 'ON' or 'OFF' position depending on the quantity in each corresponding set of fuel tanks)."

Or the item may involve "complex, time-consuming, attention-demanding activities (e.g., the single procedural step of 'programming' the FMC [flight management computer] involves entering data — numbers and letters — derived from communication with air traffic control as well as from various pieces of paperwork into nine different 'screens' or electronic pages using the FMC keyboard and may also require consulting performance charts in a binder or on a separate, hand-held computer)."

While all these actions could be considered "linear, predictable and under the moment-to-moment control of the flight crew," they involve both action and cognition in an intense interrelationship.

And that is only the *ideal* in an airline pilot's world. In the next chapter, the authors consider how the real, as experienced in line operations, adds still more complexity and variability. "Our discussion of this real world is based on an ethnographic study in which we observed a substantial number of scheduled, passenger-carrying flights from the cockpit jumpseat at two airlines," they say. Reports by pilots to the U.S. National Aeronautics and Space Administration's Aviation Safety Reporting System were also studied.

**The researchers focused on "perturbations," or additional factors that "forced the crew to alter the sequence of execution of tasks described in the FOM, disrupted the flow of work or increased the complexity of work."**

The researchers focused on "perturbations," or additional factors that "forced the crew to alter the sequence of execution of tasks described in the FOM, disrupted the flow of work or increased the complexity of work." They cite, as one example, "the frequently occurring situation in which the first officer attempted to contact the ground controller to obtain the required departure clearance but found the frequency occupied and had to monitor the radio for an opportunity to break in and make the request. We observed one instance in which the captain asked the first officer to request departure clearance while the first officer was still entering data into the FMC. The first officer chose to continue entering data while simultaneously monitoring the radio for an opportunity to make the request."

The basic problem in perturbations is not extra workload. The researchers observed that the added effort was "easily managed by experienced crews." But they say, "In this book, we develop a new perspective, going beyond traditional concepts of workload, to argue that these commonplace perturbations have a larger and more subtle significance than the simple volume of work." They may involve interleaving — "repeatedly suspending one or more tasks momentarily, engaging in another task to perform a few steps, then suspending the new task and re-engaging the previous tasks (or engaging a third task) to perform a few more steps of it until all tasks are completed."

Perturbations require pilots to "manage multiple tasks concurrently, interleaving performance of some tasks, deferring or suspending other tasks, responding to unexpected delays and unpredictable demands imposed by external agents, and keeping track of the status of all tasks. The cognitive demands imposed by managing concurrent tasks in this fashion play a central role in pilots' vulnerability to error, especially errors of inadvertent omission."

In the chapter on "Analysis of Current Task Demands and Crew Responses," the nature of perturbations is further explored. They are classified in four "prototypical situations":

- "Interruptions and distractions;
- "Tasks that cannot be executed in the normal, practiced sequence of procedures;
- "Unanticipated new tasks that arise; and,
- "Multiple tasks that must be interleaved."

The authors say, "Pilots typically respond to the concurrent task demands arising from the various operational perturbations we have described in one of two fundamental ways, either by *deferring* one or more tasks, or by *interleaving* multiple tasks. In some situations, pilots may be able to perform multiple tasks more or less simultaneously, but these situations only occur when the tasks are highly practiced together in a consistent fashion, which means that these situations are not really perturbations. Pilots may also … reduce task demands by changing how tasks are performed, either by lowering criteria for quality, accuracy or completeness of performance, or by deliberately omitting one or more tasks altogether."

In a final chapter about applications of their research, the authors offer some possibilities for ameliorating the demands on pilots caused by multitasking. They suggest that both organizations and pilots themselves must recognize and counteract the potential for errors.

For organizations, "it is crucial to thoroughly analyze reported and observed problems in routine operations, and to go beyond their surface manifestations to identify and understand the true nature of the problems encountered with existing procedures prior to designing and implementing new procedures," the authors say. "Likewise, it is critical to perform a careful analysis of the procedures, the training and the actual operations to identify underlying assumptions, and to characterize the discrepancies between the ideal and the real operating environment."

But while procedures should be devised with great care, it is futile to try to make them perfect: "Routine operations are highly dynamic and unpredictable, even if within predictable bounds. Thus, it is not possible to have a procedure for a given task that would work under all conditions, in all situations and for all operators. It is not even desirable to attempt to cover all of the known exceptions, because it would require unmanageably large FOMs. Given that some situations may fall outside the scope or language of the available procedures, operators [pilots] must be trained to recognize that these situations will increase the likelihood of error. … Training should help operators to recognize, accept and appreciate their own vulnerabilities, and to develop effective and safe personal strategies."

The authors advise individuals, "Recognizing the ways in which the prototypical situations manifest themselves in your own work environment can help you develop techniques to prevent them. For instance, recognizing the risks associated with interruptions can lead you to be very careful when you have to interrupt somebody else, and to adopt a strategic approach to letting yourself be interrupted. Such an approach will help you decide when to attend to an interruption after explicitly encoding your place in the interrupted task, or when to hold off the interruption until the current task gets to a good stopping point. Similarly, recognizing the need to respond to several different demands at once, you can call on a co-worker for help, or offer your help when you see somebody else in that situation."

They also recommend associating deferred tasks with retrieval cues in the environment. "It is important to identify the time or circumstances when the deferred intention should be performed and to identify or create specific cues that will be present at the appropriate time," the authors say. "In other words, determine and set your work environment equivalents of sticky notes, making use, when appropriate, of any alerting devices (alarm clocks, timers) that are available to you. You can also practice periodic, deliberate searches for incomplete tasks and for deferred intentions. … Deliberate searches are particularly useful in the transition points between distinct phases of an operation and following interruptions."

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## WEB SITES

### Hot Topic

**Federal Aviation Administration Fire Safety, www.fire.tc.faa.gov/index.stm**

The U.S. Federal Aviation Administration (FAA) William J. Hughes Technical Center Fire Safety Branch has aggregated a large amount of information — papers, presentations, videos, reports, regulatory and guidance documents, and other materials. Much of the Web site contents come from the Technical Center and the Cabin Safety Research Technical Group (CSRTG). All documents are free online, in full text, and may be printed and downloaded. Videos are also free and may be viewed online or downloaded.

The Technical Center's working groups — Materials Fire Test and International Aircraft Systems Fire Protection — have posted minutes and presentations from meetings held

from 2006 to 2009. Web pages for these groups contain links to research papers, reports, videos, FAA regulatory and guidance documents, and other materials related to their respective areas of focus and address topics such as extinguishers, insulation, fuel tank protection and flame propagation.

The CSRTG says, "In the past, various aviation authorities of the world were conducting research in transport category airplane cabin safety sometimes cooperatively, but mostly individually, without the benefit of a coordinating 'tool.'" In the early 1990s, civil aviation authorities from Europe, Japan, North America and the United Kingdom formed the CSRTG "to 'bring together' their respective cabin safety research efforts." Members from Australia, Russia, South America and elsewhere have since been added. "The goal of the CSRTG is to enhance the effectiveness and timeliness of cabin safety research," the group says. Additional information about the group is available from its Web page. Some of the materials appearing at the FAA Fire Safety Web site are from the CSRTG, such as the proceedings of the Fifth Triennial International Fire and Cabin Safety Research Conference held in 2007 and proceedings from the 1998, 2001 and 2004 conferences. Many of the CSRTG member organizations co-sponsor and participate in the conferences.

Two videos are featured: the final version of "Cabin Crew Fire Fighting Training" and "Laptop Battery Fires."

"Cabin Crew Fire Fighting Training" (color, audio, 21 minutes) was produced for flight and cabin crewmembers by the FAA in cooperation with CSRTG members. The video discusses the dangers of in-flight fires, especially hidden fires, and shows cabin crew searching for, detecting and extinguishing smoke and fire in ceiling and sidewall panels, galley and lavatory compartments, overhead bins, and other areas while demonstrating the proper use of various types of extinguishers and personal breathing equipment as covered in 2004 in Advisory Circular 120-80, "In-Flight Fires."

The video emphasizes a team approach in dealing with a cabin or flight deck fire, with scenarios illustrating effective communication and involvement of cabin crew, flight deck crew and passengers. "Serious fires must be brought under control within minutes," says the FAA. The overall message, "aggressive and immediate action is the key to fighting fires and saving lives," is repeated throughout the video.

Included in the video are Technical Center footage of flammability tests of aircraft materials, such as insulation and hydraulic fluids; tests of aerosol cans and overheated batteries in passenger electronic equipment; and a chemical or flammable liquid spill being extinguished in an aircraft cabin.

"Laptop Battery Fires" (color, audio, 11 minutes) was produced by the FAA. The video opens with actual footage of a laptop computer fire in an airport departure lounge. The video discusses hazards posed by batteries in laptops and illustrates effective and ineffective options for extinguishing a laptop computer fire in an aircraft cabin. "The objective is to extinguish the fire and cool the battery pack [lithium-ion cells] preventing additional cells from reaching thermal runaway [350° F, 177° C]," says the video narration.

The FAA says the Technical Center "conducts long-range research to develop a totally fire resistant passenger aircraft cabin with the goal of eliminating cabin fire as a cause of fatality." The Fire Research and Reports portions of the Web site describe the center's work and identify targeted research areas: interior panel construction, thermoplastics for molded parts, rubber for seat cushions and fibers for carpets and textiles. There is also a database of more than 700 research papers and reports on these and other aspects of fire safety research.

*— Rick Darby and Patricia Setze*

# 'Salvaged' Approach Ends Badly

**Crew miscommunication resulted in high sink rate.**

BY MARK LACAGNINA

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

## JETS

### Left Main Gear Breaks on Touchdown

Bombardier CRJ200. Substantial damage. No injuries.

The flight crew of the regional jet was completing their fourth flight of the day — from Philadelphia to Providence, Rhode Island, U.S., with 31 passengers and three crewmembers — the evening of Dec. 16, 2007. All of the flights had been conducted in instrument meteorological conditions.

"The first officer, who had recently completed his initial operating experience in the CRJ200, was the pilot flying," said the report by the U.S. National Transportation Safety Board (NTSB). "This flight was the second time he had flown from Philadelphia to Providence, and the captain was aware that he was new to the airline."

The first officer, 39, held a CRJ type rating and had 2,000 flight hours, including 150 hours in type. The report noted that he had very little instrument approach experience in CRJ200s. The captain, 30, held type ratings for the CRJ and Beech 1900, and had 5,500 flight hours, including 2,300 hours in type with 1,000 hours as pilot-in-command.

The crew was cleared to conduct the instrument landing system (ILS) approach to Runway 05. Weather conditions at the Providence airport included surface winds from 010 degrees at 8 kt, 1 3/4 mi (2,800 m) visibility in rain and mist, and a 300-ft overcast ceiling. Winds aloft at the top of descent were from 220 degrees at 100 kt, and the CRJ encountered strong tail winds as it neared the airport from the southwest.

"The crew reported feeling rushed because of the high groundspeed," the report said. "The crew did establish the airplane on the approach course at the proper speed and altitude. However, they did not perform a complete approach briefing."

The approach was stabilized until the airplane descended through 700 ft about 2 nm (4 km) from the runway. The first officer disengaged the autopilot and flight director. "In an interview, he stated that he wanted to get the feel of the airplane and 'declutter' the display," the report said. "At the time, [the airline's] procedures allowed hand flying raw-data instrument approaches."

The approach became unstabilized when the CRJ began to drift left of the localizer course and above the glideslope. When it descended below the overcast at 300 ft, the crew saw the approach lights at their 2 o'clock position. The captain offered to take control, and the first officer conceded. During the transfer of control, the captain said something that the first officer incorrectly perceived as an instruction to reduce power to idle, and he did so without the captain's knowledge.

The captain said something that the first officer incorrectly perceived as an instruction to reduce power to idle.

"The captain maneuvered the airplane in a series of descending turns reaching a maximum bank angle of 22 degrees at a height of less than 100 ft above the runway," the report said. "A descent rate of up to 2,000 fpm developed." Pitch attitude was 7 degrees nose-down when the captain began the flare, and it increased to 4 degrees nose-up just before touchdown.

The captain increased power to about 73 percent $N_1$ (low-pressure rotor speed) during the flare. Airspeed was about 132 kt on touchdown — 6 kt lower than the appropriate landing reference speed. "Due to the flare rotation and sink rate, the airplane exceeded the stall angle-of-attack, and the stall-protection system (stick shaker and pusher) briefly activated," the report said. "According to a performance study, the airplane touched down in a 9-degree left bank … with a sink rate of approximately 18 fps."

The left main landing gear collapsed, and the CRJ exited the left side of the runway and slid through a snow-covered, grassy area. All 33 people aboard the airplane exited through the airstairs door with assistance from aircraft rescue and fire fighting personnel. Postaccident examination of the three-year-old airplane revealed additional damage to the left wing's aft main spar, flaps and skin. "The left engine had minor FOD [foreign object debris] damage causing numerous nicks and cuts to about 10 fan blades," the report said.

The report said that the probable cause of the accident was "the captain's attempt to salvage the landing from an instrument approach which exceeded stabilized approach criteria" and that contributing factors included "the first officer's poor execution of the instrument approach and the lack of effective communication between the crew."

## Duck Strike Disables Engine

Boeing 767-300. Substantial damage. No injuries.

The 767 was about 800 ft above ground level (AGL) on departure from Chicago O'Hare International Airport for a flight to São Paulo, Brazil, the night of March 15, 2007, when the landing lights illuminated a flock of birds close ahead. "There were multiple bird strikes in the vicinity of the cockpit," the NTSB report said. "The left engine then experienced a series of compressor stalls."

The first officer, the pilot flying, retarded the throttle, and the left engine stabilized for a few seconds. "The first officer adjusted the throttle again, and there was one more 'bang,' after which the engine flamed out," the report said.

There were no indications of problems with the right engine. The flight crew secured the left engine, returned to O'Hare and conducted an overweight landing without further incident. None of the 203 people aboard the airplane was hurt.

Investigators found that three to five canvas back ducks weighing from 2 to 5 lb (1 to 2 kg) had struck the left engine fan section, fracturing one fan blade and damaging several others.

## Missing Fastener Causes Control Jam

McDonnell Douglas DC-10-30. Minor damage. No injuries.

Visual meteorological conditions (VMC) prevailed as the DC-10 neared Atlanta during a nonscheduled flight from Ireland the afternoon of May 2, 2007. The airplane was at 13,000 ft and decelerating to 250 kt when the autopilot out-of-trim warning light illuminated. "The autopilot was then disengaged [by the flight crew] while the flight controls were guarded in anticipation of a change in pitch," the NTSB report said.

"The airplane pitched 'aggressively' nose-down, and attempts in resetting/moving the horizontal stabilizer using the pilot's and copilot's control wheel trim switches, alternate trim switches and longitudinal trim handles were unsuccessful in repositioning the stabilizer, which remained set at 1 degree airplane nose-up."

The crew told investigators that a "demanding amount" of elevator back pressure was required to maintain level flight. They declared an emergency and received radar vectors from air traffic control (ATC) to Runway 27R. The DC-10 was landed with the flaps extended 35 degrees and the no. 2 engine at flight idle. The airplane was then taxied to a gate, where the 292 passengers and 13 crewmembers deplaned.

Investigators found that the horizontal stabilizer chain-drive assembly had been overhauled improperly. One of the two fasteners — each comprising a pin, washer and nut — securing the drive gear had been omitted during the overhaul in 1999. "The illustration in the component maintenance manual depicts only one pin, washer and nut," the report said. "However, the parts list for the same illustration specifies that two pins, washers and nuts are required to be installed."

The overhauled drive assembly was installed in the DC-10 about a year before the incident, and the airplane had accumulated 2,421 flight hours when the omission of the fastener caused the other fastener to fail. "This prevented output of the horizontal stabilizer drive assembly being transmitted to acme screws of the horizontal stabilizer," the report said. An acme screw is a powered jackscrew of the type typically used in jacks and presses.

## Mistaken Identity Leads to Near Collision

Learjet 31A. No damage. No injuries.

As the flight crew of the Learjet was taxiing to Runway 10 for departure from Dublin (Ireland) Airport the morning of Dec. 17, 2007, the pilot of an Agusta Westland A109 helicopter that had lifted off from the north apron was instructed by the airport traffic controller to hold near the control tower, which is north of Runway 10, said the report by the Irish Air Accident Investigation Unit.

The helicopter was hovering at about 200 ft AGL when the Learjet crew received takeoff clearance. The controller asked the helicopter pilot, "Do you have the traffic rolling off 10 in sight?" The helicopter pilot saw a 737 taxiing to the holding point adjacent to the approach end of the runway and replied, "Yes, affirm." The controller told the helicopter pilot that he was "cleared to pass behind that traffic, cross the active runway." The pilot read back the clearance as "cleared across the, behind the rolling traffic."

"The response of the pilot, though not precisely repeating the controller's instructions, was not ambiguous enough to cause the tower controller to question it," the report said. The controller turned his attention away from the helicopter to communicate with the crew of an aircraft that was on final approach to Runway 10.

"[The helicopter pilot] stated that he believed that the ATC controller wanted him to pass behind the taxiing B737 and to expedite the crossing," the report said. "He did not see the Learjet on the runway; he believed that this was due to it being small and gray with low light levels, as it was shortly after sunrise."

The first officer of the Learjet was the pilot flying. Soon after calling $V_2$ (takeoff safety speed), the commander saw the helicopter ahead, crossing from left to right. "The commander immediately took control, pushed the nose down and banked left to avoid a collision," the report said. "He passed below and just behind the helicopter. … There was little vertical or horizontal separation between the two aircraft at the time of the occurrence."

The helicopter pilot saw the Learjet pass a short distance behind as he crossed the runway. "After listening to the ATC recordings, the pilot of the helicopter stated that it was clear he had misunderstood the ATC controller and misidentified the aircraft in question," the report said. "He was of the opinion that, with hindsight, he should have confirmed the aircraft type and position with the controller before he crossed."

The report said that although its landing lights were on, the Learjet would have been difficult to see against the dark gray runway in the early morning light. "The investigation is of the opinion that this was probably a contributory factor in the occurrence and that it might have been helpful to the pilot of the helicopter if the controller had specifically identified the type and color of the Learjet."

**'There was little vertical or horizontal separation between the two aircraft at the time of the occurrence.'**

However, the report said that the probable cause of the serious incident was the helicopter pilot's failure to comply with the conditional clearance issued by the controller. "The pilot was listening on the VHF frequency and should have heard the takeoff clearance the ATC controller had just issued to the Learjet," the report said. "Ultimately, it was the fact that the pilot did not comply with or query the clearance that resulted in the airmiss."

### Dense Smoke Fills Cabin on Approach

Boeing 777-200. Minor damage. One serious injury.

Inbound from Shanghai, China, the afternoon of Dec. 14, 2007, the airplane was at 5,000 ft and 13 nm (24 km) from Chicago O'Hare International Airport when a cabin crewmember told the flight crew that the cabin was filling with smoke from an unknown source.

"The captain declared an emergency in order to get the airplane on the ground as soon as possible," the NTSB report said. "The first officer performed a normal landing and turned off on the first high-speed taxiway, at which time he noticed a low oil indication on the right engine."

The flight crew shut down the right engine and initiated an emergency evacuation because of the dense smoke in the cabin and the possibility of an on-board fire. During the evacuation, one of the 248 passengers sustained a fractured vertebra.

A teardown inspection of the right engine revealed that the no. 2 bearing had failed, allowing oil to enter the environmental system. "The engine manufacturer had released an improved bearing design prior to the accident," the report said. "At that time, the operator began replacing the bearings on an attrition basis when the original bearings were no longer serviceable. However, the operator has revised that policy and is proactively replacing the original bearings, regardless of condition, with the improved bearings."

### Misunderstanding Worsens Bout With Turbulence

Airbus A330-323. No damage. One serious injury, three minor injuries.

Night VMC prevailed on Dec. 25, 2007, as the A330 neared an area along the route from Osaka, Japan, to Honolulu where convective activity had been forecast. The seat belt sign was on, and the flight crew told the lead flight attendant to ensure that all the flight attendants took their seats and remained seated until further notice. The crew explained that they were deviating around an area of scattered thunderstorms "and that it should not last much longer than 15 minutes," the NTSB report said.

"The lead flight attendant reported that although it had been 'bumpy' most of the flight, when she received the call from the flight deck, it was smooth. … She walked to both galleys and told the flight attendants to be seated for the next 15 minutes." The two flight attendants in the aft galley misunderstood her instructions; believing that they had 15 minutes before they were to be seated, they finished cleaning the galley and began to prepare their crew meals.

After deviating around the thunderstorms and resuming their assigned course, the pilots discussed whether they should allow the flight attendants to resume their duties. The A330 suddenly encountered severe clear air turbulence. The encounter occurred at Flight Level 380 (approximately 38,000 ft) and 1,300 nm (2,408 km) west of Honolulu.

"The turbulence caused the autopilot and autothrottles to disconnect," the report said. "The flight lost approximately 1,000 ft of altitude during the turbulence encounter." Vertical accelerations of minus 0.4 g to 1.8 g were recorded during the brief encounter.

The two flight attendants in the aft galley were thrown to the floor. One suffered two fractured neck vertebrae; the other flight attendant and two passengers received minor injuries. The other 281 passengers and seven flight attendants, and the three flight crewmembers were not hurt.

The crew continued the flight to Honolulu, where the airplane was landed without further incident about three hours later.

## TURBOPROPS

### Salt Accretion Chokes Three of Four Engines

Lockheed WP-3D Orion. No damage. No injuries.

Operated by the U.S. National Oceanic and Atmospheric Administration (NOAA), the research aircraft was being used in an experimental project to calibrate satellite readings of low-level wind velocities over the North Atlantic. The aircraft departed in VMC from St.

John's, Newfoundland, Canada, the afternoon of Feb. 9, 2007, to investigate a low-pressure system about 500 nm (926 km) east.

"Approximately 40 minutes into the flight, the crew turned on engine anti-ice due to low outside air temperature (about minus 10° C [14° F]), periodic clouds and oncoming darkness," the NOAA report said. "Approximately an hour into the flight, the crew observed that the windshield was excessively dirty with a white film and attempted to clean it. The effort was unsuccessful due to the inoperability of the windshield washer pump. The crew described the substance as looking 'like snowflakes but not melting' [on the heated windshield]."

The flight proceeded normally for the next few hours. "Gradual reductions in power were required to maintain a set airspeed as aircraft weight decreased," the report said. "All members of the crew did note that there was much less liquid precipitation during this flight than there had been on previous flights. … Additionally, the winds noted during this flight were of exceptionally high speed. Most wind readings were in the range of 85 to 95 kt."

The technicians were completing their data acquisition when they saw flames coming from the tailpipe of the no. 3 engine and reported the observation to the flight crew. At the same time, the copilot and flight engineer observed warning indications (but no fire warning), and the commander told them to shut down the engine. The copilot was reading the emergency shutdown checklist when warning indications for the no. 4 engine were generated. "The copilot began to very carefully and methodically read the emergency shutdown checklist, declaring, 'This is for no. 3 and no. 4 now,'" the report said.

The commander increased power on the no. 1 and no. 2 engines, but airspeed began to decrease. He initiated a descent from 3,000 ft to maintain 200 kt, eventually stabilizing the aircraft at 2,600 ft. After the right engines were shut down, the copilot told the crew to review their ditching procedures and don their anti-exposure suits. He also told the off-duty navigator to declare an emergency.

Five minutes later, tailpipe flames and warning indications were observed for the no. 1 engine, and it also was shut down. "The aircraft began a descent at about 700 fpm, unable to hold altitude on the power of one engine," the report said. "Failing other options, the commander called for an immediate restart of the no. 1 engine."

**'The aircraft began a descent at about 700 fpm, unable to hold altitude on the power of one engine.'**

The Orion passed through a rain shower as the no. 1 engine was restarted. "The aircraft reached a minimum altitude and airspeed of 800 ft and 140 kt prior to beginning a slow climb on two engines," the report said. The right engines then were restarted, and the aircraft was flown at 14,000 ft back to St. John's, where it was landed without further incident about 6 1/2 hours after it departed.

Initial examination of the aircraft revealed a significant buildup of a white substance on the engine intakes and first-stage compressor stator and rotor blades, and on the fuselage and windows. Testing of samples by Rolls-Royce confirmed that the white substance was sodium chloride — salt.

The investigation concluded that the engine rundowns had been caused by an "almost unknown phenomenon" — salt accretion. Sea salt borne by the hurricane-force winds had been deposited on the low-flying Orion, and enough of the accreted salt had been washed from the engines during the brief encounter with the rain shower to allow the engines to be restarted and to run smoothly during the remainder of the flight.

The report noted that factors that can contribute to salt accretion include: a large difference between the temperatures of warm water and cold air; high surface wind speeds; absence of precipitation; and relative humidity at or above 80 percent.

### GPU Struck After Engine Start

Fokker F27 500. Substantial damage. No injuries.

The flight crew was preparing for a cargo flight from Edinburgh, Scotland, to Coventry, England, the night of Feb. 1, 2008. While conducting the "Before Start" checklist, the copilot called "parking brake," expecting the commander to reply "set." However, they were interrupted when a company engineer announced that the nosewheel was chocked, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The engines were started with the aid of a ground power unit (GPU) stationed in front of the right wing. The commander used hand signals to instruct the marshaller to disconnect the GPU. The marshaller and his assistant were attaching the GPU to a tow vehicle when they saw the aircraft, which was parked facing down a slight incline on the ramp, begin to move forward. "They both ran clear of the aircraft as it continued to move forward," the report said.

The pilots were conducting the "After Start" checklist and did not notice that the aircraft was moving. "It continued to move forward until its right propeller struck the GPU, causing substantial damage to the GPU, the propeller and the engine," the report said.

The crew shut down the remaining engine and secured the aircraft. "Once outside, the commander noticed that there were no chocks in the vicinity of the nosewheel," the report said. "The airport fire and rescue services (AFRS) were on scene within two minutes. Upon arrival, they chocked the nosewheel, as no chocks were present, and laid a blanket of foam beneath the right engine to cover the leaking fuel."

Investigators were unable to determine conclusively why the Fokker moved forward. "Possible explanations include that the parking brake was not set, the chocks had slipped from the nosewheel, or the chocks were removed prematurely," the report said. "There was insufficient evidence to determine which of these scenarios was the most likely."

## PISTON AIRPLANES

### Haste Makes Waste

Pilatus Britten-Norman Islander. Substantial damage. Three minor injuries.

The pilot was preparing the aircraft for a positioning flight from Wallblake Airport in Anguilla, a British territory in the Lesser Antilles, to pick up cargo on the neighboring island of St. Maarten the afternoon of Feb. 2, 2008. The AAIB report said that he was distracted by efforts to accommodate two nonrevenue passengers, including installation of an extra seat.

"Witnesses stated that the [pilot] appeared rushed prior to departure," the report said. "He did not complete a preflight check." After starting the engines, he realized that the nosegear chocks were still in place. He shut down the left engine, removed the chocks and restarted the engine.

After taking off from Runway 10, the pilot began a left turn at about 150 ft AGL. "After some initial movement, the ailerons jammed," the report said. "When the pilot discovered that he was unable to straighten the ailerons, he attempted to return to land on Runway 10."

The pilot rejected the landing because the aircraft was too high and airspeed was excessive. "He continued the left turn, losing height and speed to position the aircraft for another approach, but as the aircraft descended over the northern edge of the runway, its left wing struck the perimeter fence." The Islander touched down in a wings-level attitude and slid about 80 ft (24 m) before stopping. There was no fire.

"On vacating the aircraft, the commander noticed that the left aileron gust lock was still in place," the report said.

### Jump Plane Stalls During Turn

Cessna P206. Destroyed. Two fatalities, two serious injuries.

The airplane departed from Mount Vernon (Missouri, U.S.) Municipal Airport the afternoon of April 29, 2008, with six skydivers aboard. "Surviving skydivers said that as the airplane was climbing to the jump altitude of 10,500 ft, the stall warning horn sounded intermittently," the NTSB report said. "They paid no particular attention to it because they had heard it on previous flights."

After reaching jump altitude, the pilot began a turn toward the drop zone. The stall warning horn sounded, and the 206 rolled right and entered a spin. Four skydivers bailed out. Three reached the ground safely; the fourth was hit by the airplane's horizontal stabilizer and suffered a broken leg before she deployed her parachute.

Another skydiver was killed after her reserve parachute deployed and became entangled with the empennage. "The sixth skydiver was unable to exit the airplane and was found inside, fatally injured," the report said. "The pilot was seriously injured."

The report said the probable cause of the accident was "the pilot's failure to maintain adequate airspeed" and that a contributing factor was "the entanglement of the parachute in the elevator control system, reducing the pilot's ability to regain control."

### Fuel Leak Causes Engine Fire

Douglas C-54G-DC. Substantial damage. No injuries.

The cargo aircraft, a military version of the DC-4, was climbing through 3,500 ft during departure in VMC from Norman Wells, Northwest Territories, Canada, the evening of Jan. 5, 2006, when a fire erupted in the no. 2 engine nacelle. The flight crew conducted the "Engine Fire" checklist, which included shutting down the engine and closing the firewall shutoff valve, but the fire continued.

"During this period, an uncommanded feathering of the no. 1 propeller … occurred," said the report by the Transportation Safety Board of Canada. "The crew planned for an emergency off-field landing, but during the descent to the landing area, the fuel selector was turned off as part of the 'Engine Securing' checklist, and the fire self-extinguished. A decision was made to return to the Norman Wells Airport, where a successful two-engine landing was completed."

Investigators found that the fire had originated with a leak from the main fuel line. Closing the firewall shutoff valve — which stops the flow of fuel, oil and hydraulic fluid to the engine — did not extinguish the fire because it had spread from the engine compartment and burned through an aluminum fuel line in the wheel well behind the firewall. "If the fuel selector had been turned off as part of the initial 'Engine Fire' checklist, the fire would have been extinguished earlier," the report said.

The report also noted that the aluminum fuel line and its couplings and clamps had not been replaced with a flexible hose assembly as required by an airworthiness directive issued in 1948 to prevent engine fires.

The propeller on the no. 1 engine likely feathered because of damage to electrical components for the feathering system located in a junction box in the no. 2 engine nacelle.

## HELICOPTERS

### Bearing Failure Causes Severe Vibration

Eurocopter AS 355-F1. Substantial damage. No injuries.

The pilot encountered control problems when the helicopter began to vibrate severely while departing from Wellington, New Zealand, the afternoon of April 13, 2008. "Despite the vibration and limited control, the pilot completed a successful emergency landing in a nearby sports field," said the report by the New Zealand Transport Accident Investigation Commission (TAIC).

Investigators found that one of the three main rotor blade spherical thrust bearings had failed because the internal elastomer had deteriorated and debonded, allowing corrosion to occur. TAIC recommended a review of the adequacy of bearing-inspection procedures.

### Wind Shift Spoils Takeoff

Schweizer 269C. Substantial damage. No injuries.

The pilot landed in an area he described as "a 3/4-mi [1-km] diameter bowl-like depression" near Buffalo, Wyoming, U.S., to pick up a passenger on June 24, 2008. "He loaded the passenger, and they departed," the NTSB report said. "However, during acceleration to ETL [effective translational lift] airspeed … the rotor speed began to decay."

After landing on a slope, the helicopter rolled back, and the tail rotor struck the ground. The accident occurred at 4,300 ft. "After the accident, the pilot walked up an embankment … to observe the wind conditions," the report said. "He noted that the winds had shifted 180 degrees from his initial, pre-accident observation."

## Preliminary Reports

| Date | Location | Aircraft Type | Aircraft Damage | Injuries |
|---|---|---|---|---|
| Feb. 4, 2009 | Rostadalen, Norway | Aerospatiale AS 350B-3 | destroyed | 1 fatal |
| The pilot was killed when the Ecureuil helicopter crashed in a snowstorm during a positioning flight from Harstad to Alta. | | | | |
| Feb. 5, 2009 | Zadar, Croatia | Cessna 303 Crusader | destroyed | 4 fatal |
| The airplane was on a training flight from Zagreb when it crashed in mountainous terrain during an approach in fog. | | | | |
| Feb. 7, 2009 | Santo Antônio, Brazil | Embraer 110P1 Bandeirante | destroyed | 24 fatal, 4 serious |
| An engine failed during a scheduled flight from Coari to Manaus in heavy rainfall. The flight crew was attempting to land at an unused airport when the airplane crashed in the Manapuru River. | | | | |
| Feb. 7, 2009 | Trigoria, Italy | Cessna Citation 650 | destroyed | 2 fatal |
| The Citation III struck terrain about four minutes after departing from Rome in marginal visual meteorological conditions to pick up a medical team in Bologna. | | | | |
| Feb. 10, 2009 | Budaors, Hungary | Robinson R44 | destroyed | 1 fatal, 2 minor |
| A passenger was killed when the helicopter descended into the Danube River after the tail struck a crane during an aerial photography flight. | | | | |
| Feb. 11, 2009 | Boma, Sudan | Cessna 208 Caravan | destroyed | 3 none |
| A landing gear strut broke during landing. The occupants exited the airplane before it became engulfed in flames. | | | | |
| Feb. 12, 2009 | St. Moritz, Switzerland | Dassault Falcon 100 | destroyed | 2 fatal, 1 serious |
| The pilots were killed when the fuselage broke in two behind the cockpit after the Falcon struck a snowbank during landing. | | | | |
| Feb. 12, 2009 | Clarence, New York, U.S. | Bombardier Q400 | destroyed | 50 fatal |
| An ice-related stall might have occurred before the airplane descended into a residential area about 5 nm (9 km) from Buffalo-Niagara International Airport during an instrument approach to Runway 23. The fatalities included one person on the ground. | | | | |
| Feb. 14, 2009 | KwaXimba, South Africa | Cessna 182P | destroyed | 1 fatal, 5 serious |
| The engine failed during takeoff for a skydiving flight. Two skydivers jumped safely before the 182 struck the ground. | | | | |
| Feb. 15, 2009 | Chanco, Chile | Bell UH-1H | destroyed | 13 fatal |
| Dense mist was reported in the area where the helicopter crashed into a hill while transporting forest firefighters. | | | | |
| Feb. 15, 2009 | Isfahan, Iran | Antonov An-140 | destroyed | 5 fatal |
| A training flight was being conducted for the manufacturer, HESA Iran, when the airplane crashed on approach. | | | | |
| Feb. 17, 2009 | Jaroslaw, Poland | Mil Mi-2 | destroyed | 2 fatal, 1 serious |
| Dense fog and snow prevailed when the emergency medical services helicopter crashed en route to the site of a highway traffic accident. | | | | |
| Feb. 18, 2009 | North Sea | Eurocopter EC 225LP | substantial | 18 none |
| The Super Puma helicopter was ditched for unknown reasons during an approach in low-visibility conditions to a platform 125 nm (232 km) east of Aberdeen, Scotland. | | | | |
| Feb. 19, 2009 | Nome, Alaska, U.S. | Piper Chieftain | substantial | 1 serious, 5 minor |
| During a commuter flight from Brevig Mission, the pilot received a special visual flight rules clearance to Nome Airport, which had 1 1/2 mi (2,400 m) visibility and a broken ceiling at 900 ft. The airplane struck snow-covered terrain about 5 nm (9 km) from the airport. | | | | |
| Feb. 19, 2009 | San Onofre, California, U.S. | McDonnell Douglas 600 | destroyed | 1 serious, 2 minor |
| The pilot conducted an autorotative landing in shallow water near a beach after reporting engine problems during a border-patrol flight. | | | | |
| Feb. 20, 2009 | Luxor, Egypt | Antonov An-12 | destroyed | 5 fatal |
| The cargo ariplane crashed shortly after taking off for a ferry flight to Nikolaev, Ukraine. | | | | |
| Feb. 25, 2009 | Amsterdam, Netherlands | Boeing 737-800 | destroyed | 9 fatal, 125 NA |
| En route from Istanbul, Turkey, the 737 crashed in a farm field 1.5 km (0.8 nm) from Schiphol Airport during an approach to Runway 18R. | | | | |

NA = not available

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