AeroSafety WORLD

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First annual report

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Training at the top of the list

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Flight attendants get tired, too

DOUBTS ABOUT GPS
LOOKING AT DISTURBING REPORT

THE JOURNAL OF FLIGHT SAFETY FOUNDATION
JUNE 2009

Politics

I often hear from safety professionals that their efforts are limited by the number of hours in a day, and that mandatory regulatory requirements always take precedence over the critical work of mitigating and assessing risk. It will be that way for a long time. As I have said before, the public and politicians are fascinated with compliance and ignorant of risk (*ASW*, 8/08, p. 1). This is one of the reasons that the Foundation spends so much time trying to keep politics away from real safety issues.

It looks like we have another opportunity to do that. Labor organizations in the U.S. have launched a major political campaign to limit or eliminate the use of foreign maintenance by U.S. airlines (*ASW*, 5/09, p. 5). I would never deny anyone the right to stand together and fight to protect their jobs. As a matter of fact, I helped organize a union once. Unions have a place in the process, and I support that. What can't be supported is the use of safety to justify the argument. We have looked around and asked for data from many members. The fact is that we just can't find a problem; it seems that most of these repair stations are continually audited by regulators and by customers. The amount of scrutiny they receive is amazing.

For that reason, the Foundation recently issued a press release saying, "We have seen no evidence whatsoever that aircraft maintenance performed by non-U.S. repair stations is any less safe than that performed within the U.S., provided the repair stations and personnel are properly certificated and regulated."

The Foundation is not, and never will be, a political organization. Yet it has to deal with threats to aviation safety — and lately the threats seem to be increasingly political. It is left to the Foundation to state the facts. The U.S. is just one part of a global system. It cannot regulate the world and shouldn't try. Good safety oversight happens when regulators exchange information, watch each other's backs, and hold each other accountable. When a regulator works in isolation, it creates the opportunity for a single point failure. When they work in concert, each one provides a redundant layer of safety. Using regulators to reinspect repair stations they already know to be safe is not just an annoyance, it is an opportunity lost. The resources that are expended recertifying aircraft, pilots and facilities are diverted from the real work of risk identification and mitigation.

The U.S. Federal Aviation Administration–European Aviation Safety Agency Bilateral Safety Agreement will allow these regulators to work with each other's data and accept each other's certifications where appropriate. It is the way countries will have to act in the future. It lets people focus on risk instead of bureaucracy.

For all of these reasons, the Foundation is going to have to enter this argument. Not because we care about the politics of the issue — we don't. We just don't want those politics to derail the system of cooperation and mutual recognition that helps make this global industry safe.

It isn't about the politics, it is just about safety.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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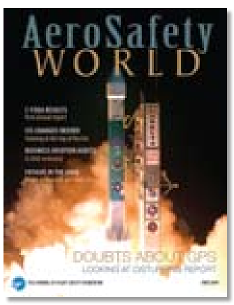

About the Cover
Report says GPS replacements will lag need.
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AeroSafetyWORLD

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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.

MemberGuide

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NASTY Stew

It was a nasty safety stew made with many of the ingredients that have been in our cookbook for years — training, fatigue and cockpit discipline. Throw in some icing, and this concoction yielded tragic results just short of the runway in Buffalo, New York, U.S., on a winter night.

The crash of a Colgan Air Bombardier Q400 on Feb. 12, 2009, killed 50 people. The fatalities, and the issues involved, ensured that this accident would grab a good deal of attention. Changes likely will be coming as a result of this investigation, changes that in some cases are long overdue.

One of the more central and interesting aspects of this case was the sleep, or lack thereof, and the quality of the sleep that the two pilots were able to get in the crew rest lounge after long commutes to get to their departure point. The fatigue effect on pilots commuting thousands of miles from their home to their current domiciles has been under-discussed forever. In many ways, it has been a very old-school discussion of a type seldom heard in modern aviation safety circles: It doesn't cause a problem, so let's not talk about it.

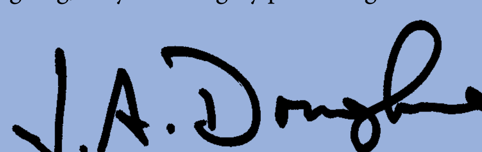
Commuting, in fact, allows airlines to operate the way that they do, especially smaller carriers with a high work force turnover. If airlines didn't do it the way it's been done for decades, turning a blind eye toward the practice and accommodating crewmembers in empty seats, they would be faced with a smaller pool of pilots from which to hire, restricted to those already living around the domicile or those willing to relocate. But the willingness to relocate is impacted by the fluid nature of many airlines' route systems that see many changes, even seasonal changes. Further, how many pilots can afford to move as often as airlines might desire, especially given the salaries pilots get at smaller airlines? Not that they mind the low pay, at least for a while, considering that the experience is a form of apprenticeship, paying their dues, scuffling to get by to start moving up the airline hierarchy.

This revolving door at smaller carriers is also part of the ingrained system. Hard-pressed airline human resources specialists are tasked with filling a continuous need for highly trained and well-experienced pilots to keep the schedules flying, and most pilots already employed are continually looking for that big payday that accompanies a move to the big carriers. Oddly enough, this accident, with its overtones of potential pilot inadequacy, comes during a time of airline retraction.

We at Flight Safety Foundation and others around the world a couple of years ago became very concerned about the supply of sufficiently trained personnel. Since then, the global recession turned down the heat on the issue, but heat remains. The system needs a continuous flow of people to cope with personnel losses through retirements, failed medical exams and other reasons that cause pilots to leave the system.

And this kind of pressure on the labor force puts pressure on training systems and training costs. Again, regional airlines suffer from having far fewer full flight simulators per pilot than their larger brethren, a simulator often costing as much as the airplane it is simulating. This pressure squeezes the training footprint, so a captain may never experience a stickshaker or stickpusher in action until short final in an ice storm.

All of these issues, and more, are being brought to light as a result of the Buffalo accident. I, for one, look forward to the solutions being proposed. In the early going, they seem highly promising.



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

JUNE 2–4 ➤ 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 8–13 ➤ Human Factors in Flight Safety: Risk Management and Accident Investigation. European Association for Aviation Psychology and the Swiss Air Force. Interlaken, Switzerland. Sonja Streun, <sonja.streun@vtg.admin.ch>, <www.eaap.net/courses>, +41 44 823 25 42; Brent Hayward, <bhayward@dedale.net>.

JUNE 9–10 ➤ Managing Human Error in Complex Systems: An Introduction to HFACS and HFIX. Wiegmann, Shappell, & Associates. Las Vegas. Scott A. Shappell, <shappell@errorsolutions.com>, <www.hfacs.com/services_hfacs.html>, +1 405.640.5479.

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 9–11 ➤ 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 22–25 ➤ Airport Emergency Planning and Exercise Implementation. Avsec Center.org. Fort Pierce, Florida, U.S. <training@avsec-center.org>, <www.avsec-center.org>, +1 214.889.7570.

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.

JUNE 28–JULY 3 ➤ ISAP9: 4th International Summer School on Aviation Psychology. University of Graz and Austrian Aviation Psychology Association. Graz, Austria. Wolfgang Kallus, <wolfgang.kallus@uni-graz.at>, <www.uni-graz.at/isap9>, +43 316 380 5129.

JULY 7–9 ➤ Deicing Conference. Airports Council International–North America and Air Transport Association of America. Cincinnati. <meetings@aci-na.org>, <www.aci-na.org/conferences/detail?eventId=142>, +1 202.293.8500.

JULY 8–9 ➤ Safety Management System Overview Workshop. ATC Vantage. San Francisco. <registrations@atcvantage.com>, <www.atcvantage.com>, +1 727.410.4759.

JULY 13–15 ➤ Symposium on Regional Aviation Safety Agencies (RASA). African Civil Aviation Commission, European Aviation Safety Agency and AviAssist Foundation. Livingstone, Zambia. Dominika Vielhauer, <dominika.vielhauer@easa.europa.eu>; Mesfin Fikru, <mesfinfikru@yahoo.com>; <www.aviassist.org>.

JULY 13–17 ➤ Safety Management System Principles Course. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Page McCanless, <mpthomps@mitre.org>, <mai.mitrecaasd.org>, +1 703.983.6799.

JULY 13–22 ➤ Safety Management System Theory and Application Course. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Page McCanless, <mpthomps@mitre.org>, <mai.mitrecaasd.org>, +1 703.983.6799.

JULY 16–17 ➤ Implementing LOSA and TEM Into Your Organization Course. Morning Star Aviation Consulting. Denver. David Bair, <DLBair@comcast.net>, <www.regonline.com/builder/site/Default.aspx?eventid=127619>, +1 720.981.1802.

AUG. 3–6 ➤ Air Safety and Security Week. Air Line Pilots Association, International. Washington. <crewroom.alpa.org/safety/?tabid=2427>, +1 703.689.2270.

AUG. 18–20 ➤ Human Factors in Aviation Maintenance Course. Southern California Safety Institute. San Pedro, California, U.S. Rick Anglemyer, <rick.anglemyer@scsi-inc.com>, <www.scsi-inc.com/HFAM.html>, 800.545.3766, ext. 103; +1 310.517.8844, ext. 103.

AUG. 26–27 ➤ Safety Management System Overview Workshop. ATC Vantage. Denver. <registrations@atcvantage.com>, <www.atcvantage.com>, +1 727.410.4759.

SEPT. 2–3 ➤ 21st FAA/ATA International Symposium on Human Factors in Maintenance and Ramp Safety. U.S. Federal Aviation Administration and Air Transport Association of America. San Diego. Sherri Brooks, <sherri.brooks@gmail.com>, <www.airlines.org/operationsandsafety/events/2009hfsymposium.htm>, +1 304.872.5670.

SEPT. 9–11 ➤ Sixth Annual FAA International Aviation Safety Forum. American Association of Airport Executives. Washington. Jacky Sher Raker, <jacky.raker@aaae.org>, <www.aaae.org/meetings/meetings_calendar/mtgdetails.cfm?MtgID=90902&RecID=723>, +1 703.824.0500.

SEPT. 14–17 ➤ Bird Strike North America Conference. Bird Strike Committee Canada. Victoria, British Columbia, Canada. Carol Liber, <events@theplanner.net>, <www.birdstrikecanada.com/CanadaConference.htm>, +1 604.276.7471.

SEPT. 14–18 ➤ ISASI 2009: Accident Prevention Beyond Investigations. International Society of Air Safety Investigators. Orlando, Florida, U.S. Sharon Morphew, <sharon.morphew@scsi-inc.com>, <www.isasi2009.org/index.html>.

SEPT. 21–24 ➤ 52nd Annual Non-Destructive Testing Forum. Air Transport Association of America. Atlanta. Mark Lopez, <mlopez@airlines.org>, <www.airlines.org/2009NDTForum>, +1 202.626.4125.

SEPT. 29–OCT. 1 ➤ Third International Helicopter Safety Symposium. International Helicopter Safety Team. Montreal. Somen Chowdhury, <schowdhury@bellhelicopter.textron.com>, +1 450.971.6500, ext. 2787; Kay Brackins, <kay@vtol.org>, +1 703.684.6777; <ihst.rotor.com/Default.aspx?tabid=1507&nnpg2918=1&language=en-US>.

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

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

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

Safety News

Fire Prompts Safety Proposals

The U.S. National Transportation Safety Board (NTSB), citing a Sept. 28, 2007, in-flight fire on an American Airlines McDonnell Douglas MD-82 during departure from St. Louis, has recommended an evaluation of all instances of uncommanded air turbine starter-valve opening events in MD-80s.

The evaluation by the U.S. Federal Aviation Administration is necessary to determine whether modifications should be ordered, the NTSB said.

The St. Louis incident occurred during the departure climb and prompted the crew to return to Lambert-St. Louis International Airport for an emergency landing. During the return, the nose landing gear did not extend, and the crew conducted a go-around while performing the emergency gear-extension procedure. None of the 143 people in the airplane was injured, but the aircraft sustained substantial fire damage.

U.S. National Transportation Safety Board

The NTSB said that the probable cause of the accident was the failure of maintenance personnel to use an appropriate manual engine-start procedure. That failure led to "the uncommanded opening of the left engine air turbine starter valve (ATSV) and a subsequent left engine fire, which was prolonged by the flight crew's interruption of an emergency checklist to perform nonessential tasks."

The NTSB cited deficiencies in the airline's continuing analysis and surveillance system as a contributing factor.

The accident report said that, during the brief flight, the pilots observed an "uncommanded opening of the ATSV …, followed by indications of an engine fire" and several other electrical and hydraulic anomalies.

The investigation resulted in eight NTSB recommendations to the FAA, including one proposal to establish best practices guidelines for training in single and multiple emergencies and abnormal situations, and another to require principal operations inspectors "to review their operators' pilot guidance and training on task allocation and workload management during emergency situations to verify that they state that, to the extent practicable, the pilot running the checklists should not engage in additional nonessential operational tasks, such as radio communications."

A recommendation to American Airlines called for an evaluation of the company's continuing analysis and surveillance system to determine why it did not identify deficiencies in the maintenance program associated with the ATSV.

Wildlife-Risk Center

Embry-Riddle Aeronautical University is establishing a center for research on methods of reducing the risks to aircraft of wildlife strikes.

The International Center for Aviation and Wildlife Risk Mitigation, to be located at the university's campus in Prescott, Arizona, U.S., is part of a larger effort to overhaul the bird strike hazard management system in the United States.

"We created this center to support data collection efforts, develop better solutions to reduce wildlife strike hazards and serve as a clearinghouse to share this information with industry and organizations that need it," said Archie Dickey, an associate professor of aviation environmental science and the director of the center.

Wildlife strikes are blamed for more than $500 million in losses for civil aviation in the United States and cause more than 500,000 hours of aircraft down time.

Dickey said several promising new methods of managing wildlife around airports include using marine radar to detect birds and mowing grass near airports to a height of 6 to 12 in (15 to 30 cm) to discourage the presence of larger birds.

In a related development, the U.S. Federal Aviation Administration (FAA) has reversed an earlier position and has made public virtually all information in its bird strike database.

Some information from the database has been available to the public since it was first collected in 1990. The FAA's

© Dreamstime

action in April made public all data except personal telephone numbers and other privacy information.

The FAA plans significant improvements over the next few months in the database, including development of a more efficient search engine. The improvements should be completed later this year, the FAA said.

The database is available at <wildlife-mitigation.tc.faa.gov/public_html/index.html#access>.

Aid to Zambian Aviation

Wikimedia

The AviAssist Foundation, a regional affiliate of Flight Safety Foundation, has agreed help boost European Commission support for aviation safety improvements in Zambia.

The effort, to be funded by the European Development Fund, is designed to establish priorities for improvement. The overall objective in Zambia is to "build capacity on regulatory and operational issues in the specific areas of air safety, security and traffic management," AviAssist said.

Investigative Assistance

The Australian and International Pilots Association (AIPA) and the Australian Transport Safety Bureau (ATSB) have approved an agreement under which AIPA pilots may be called upon to assist the ATSB in accident investigations.

The AIPA described the agreement as the first of its kind, and one that "recognizes the wealth of expertise that current and former pilots have and are willing to contribute to safety investigations to prevent incidents from recurring."

AIPA President Barry Jackson said the pilots "obviously have a lot to offer investigations in terms of hands-on experience and knowledge of the aircraft."

© Lars Lindenblade/iStockphoto

ATSB Executive Director Kym Bills said that, when accidents and incidents occur, "the opportunity to learn from past mistakes and improve future safety could be enhanced through an agreement like this. It's a positive sign to see people with knowledge and expertise in the operating environment willing to step forward, where needed, to volunteer their time in a safety investigation."

Battery Protection

New procedures should be ordered for Boeing 757/767 crews to avoid the complete loss of battery power in case of an illuminated "STANDBY POWER BUS OFF" light, the U.S. National Transportation Safety Board (NTSB) says.

The NTSB said the U.S. Federal Aviation Administration (FAA) should require Boeing to revise the procedures and training to "include landing at the nearest suitable airport before the power is depleted, and actions to take if landing is not possible." After the procedures have been revised, the FAA should require all operators of 757s and 767s to adopt them, the NTSB said.

The NTSB said its recommendations were prompted by preliminary findings in the investigation of a Sept. 22, 2008, accident in which an American Airlines 757-200 experienced in-flight electrical system anomalies and then ran off the side of a runway during an emergency landing at Chicago O'Hare International Airport. None of the 192 people in the airplane was injured in the accident, which caused minor damage to the airplane.

The captain told investigators that the "STANDBY POWER BUS OFF" light had illuminated during the flight from Seattle to New York, and the crew — following procedures outlined in the quick reference handbook (QRH) — moved the standby power selection knob to the "BAT" position. This should have enabled the battery to provide enough standby power for 30 minutes, but several systems were inoperative, the captain said.

The crew contacted maintenance personnel, who said they could continue the flight. However, about one hour and 40 minutes later, the battery power was depleted and "numerous cockpit systems began to fail," the NTSB said.

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The crew diverted to O'Hare. As the airplane neared the runway for landing, the crew noticed that the primary and standby elevator trim systems had failed. The captain said that during the landing rollout, the thrust reversers and spoilers did not deploy properly and the brakes did not function well.

"Because of obstructions off the end of the runway, the captain elected to steer the airplane off the left side of the runway into the grass," the NTSB said.

An inspection of the airplane showed that a relay failure had left the standby electrical buses without power. "Further investigation determined that moving the standby power selector to the BAT position (per the procedures in the existing QRH) resulted in the main aircraft battery providing power to four electrical buses; it also disconnected the main battery charger from the battery, and thus the battery was no longer being recharged."

Fatigue Forum

© Brian A. Jackson/iStockphoto

A group of airlines, along with the research firm Qinetiq, have established a fatigue risk management system (FRMS) forum designed to encourage discussion of fatigue issues and the best practices for developing an FRMS as part of an operator's safety management system (SMS).

SMS is required by the International Civil Aviation Organization and fatigue is considered one of the primary risks that an SMS must address.

The forum is intended to serve as a vehicle for sharing knowledge about developing and managing an FRMS, and may result in development of downloadable documents and templates to be made available for members' use. Early supporters of the forum include Air New Zealand, easyJet, Delta Air Lines, Virgin and Qinetiq.

"The benefits of managing fatigue like any other risk within an SMS are significant," Qinetiq said. "Reasons for investing in an FRMS include not only complying with flight time limitations but also to protect commercial performance through the measurement and quantification of exposure to risk from errors made as a consequence of increasing human fatigue. By understanding the nature of fatigue risk, operators may manage it effectively for continued safe operation and viability in the commercial environment."

In Other News …

Japan and the United States have signed a **bilateral aviation safety agreement** that allows for reciprocal certification of aircraft and aviation products. … The U.K. Civil Aviation Authority has published a new *Safety Plan* outlining a "more holistic and risk-based approach to the management of safety" in the U.K. aviation system. … The Commercial Aviation Safety Team (CAST) has won the **Collier Trophy**, awarded annually by the U.S. National Aeronautic Association. CAST was praised for "achieving an unprecedented safety level in U.S. commercial airline operations by reducing risk of a fatal airline accident by 83 percent, resulting in two consecutive years of no commercial scheduled airline fatalities."

More Scrutiny for Regionals

U.S. Federal Aviation Administration (FAA) inspectors have been ordered to focus more attention on training programs at regional airlines to ensure that the airlines are in compliance with federal regulations.

In a joint statement, Transportation Secretary Ray LaHood and FAA Administrator Randy Babbitt said that their action was a response to the Feb. 12, 2009, crash of a Colgan Air Bombardier Q400 during an approach to Buffalo-Niagara International Airport in Buffalo, New York, U.S. All 49 people in the airplane and one person on the ground were killed in the crash, which destroyed the airplane.

"It's clear to us in looking at the February Colgan Air crash in Buffalo that there are things we should be doing now," Babbitt said in announcing the stepped-up inspections. "My goal is to make sure that the entire industry — from large commercial carriers to smaller regional operators — is meeting our safety standard."

Babbitt and LaHood said that, although the investigation by the U.S. National Transportation Safety Board is continuing, regulators and the industry should not wait for the final report to correct problems that already have been identified in regional airline operations.

A mid-June meeting of representatives of regional airlines, their air carrier partners, aviation industry groups and labor organizations was called to review issues affecting the industry, including pilot training and cockpit discipline. Items on the agenda included discussions of air carrier management responsibilities for crew education and support; professional standards and flight discipline; training standards and performance; and mentoring relationships between mainline air carriers and their regional partners.

Rudi Riet/Wikimedia

Compiled and edited by Linda Werfelman.

Keep Asking "Why?"

Thank you for the excellent article on the Coast Air ATR 42 incident (*ASW*, 3/09, p. 32). It has been the subject of two long discussions here as an excellent example to illustrate organizational latent conditions leading to mishaps.

One small thing that you might want to think about — the first sentence of the article: "The airline's failure to promptly update its standard operating procedures was among organizational deficiencies that contributed to the loss of control of an ATR 42-320 during an encounter with severe icing … ."

As part of our safety management system curriculum here, we try to steer people away from statements such as, "The pilot failed to … ," for two reasons. First, such formulations reinforce a blame culture and put all the onus on a single entity. Second, since blame has been placed, they stop the process of asking "why?" that ultimately can result in finding several reasons why the organizational latent conditions led to the incident.

This is not to say that the statement, "The airline's failure to promptly update … " is not true. It is. But for the purpose of identifying all the latent conditions, it may not be a productive statement.

Again, thank you for your fine work. Please take these comments in the spirit they are intended, which is that through good faith dialogue we can best reach the truth.

Thomas Anthony
Aviation Safety and Security Program,
Viterbi School of Engineering
University of Southern California

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

Write to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, or e-mail <donoghue@flightsafety.org>.

POSITIONING, *Navigation* AND TIMING

BY WAYNE ROSENKRANS

The risk of insufficient GPS satellites is practically negligible in 2009–2015, the U.S. Air Force says, despite auditor concerns about civil air transport.

Reassurances by the U.S. Air Force in early May — a few days after the U.S. Government Accountability Office (GAO) reported on risks of delayed satellite replenishment in the global positioning system (GPS) — aimed to minimize system-user doubt arising from the report's warning of potential future problems in infrastructure critical to civil aviation. The GAO report essentially questioned whether the Air Force program to replace worn-out GPS satellites will move quickly enough to sustain today's higher-than-required level of positioning, navigation and timing (PNT) services, which air carriers and other aviation operators expect to nearly always be available.[1,2]

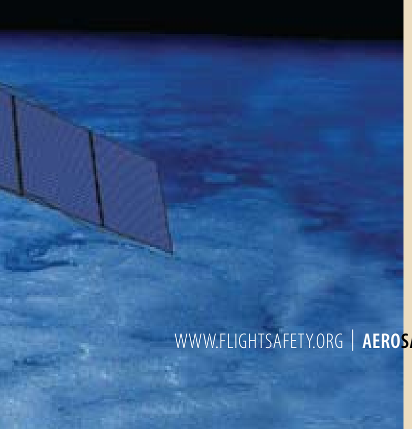
"It is uncertain whether the Air Force will be able to acquire new satellites in time to maintain current GPS service without interruption," the report said. "If not, some military operations and some civilian users could be adversely affected. … This would not only have implications for military users but also for the larger community of GPS users, who may be less aware and equipped to deal with gaps in coverage. … It is unclear whether the user community knows enough about the potential problem to do something about it."

Aviation professionals were reminded why precise, stable and reliable PNT services at all times from the nominal GPS constellation — that is, a healthy satellite in each of 24 primary slots making a 12-hour orbit at an altitude of 20,182 km (10,897 nm) — should not be taken for granted while the current upgrade program continues through 2023. Few of the GAO report's findings were disputed by the U.S. Department of Defense (DoD), but the interpretation of forecasts and their significance remained points of disagreement. The findings tend to be magnified by increasing U.S. public awareness of and political sensitivity to the Next

The Boeing Company

U.S. Air Force (Photo: Carlton Bailie, United Launch Alliance)

The first GPS block IIF satellite, to the lower right in the illustration, in late 2009 will replace older generations that often operate for twice their design life. Above, a Delta II rocket boosts a GPS block IIR-M satellite into orbit.



Generation Air Transportation System's (NextGen's) dependence on infrastructure enabled by GPS to deliver promised levels of airline safety and efficiency.

By GAO calculations, a two-year delay in the production and launch of the first GPS III–generation satellites in 2014 probably would reduce the current GPS II constellation to fewer than 24 satellites for five years and reduce the probability of providing 24 healthy satellites to less than 95 percent for 12 years. "The delay in GPS III would reduce the probability of maintaining a 21-satellite constellation to between 50 and 80 percent for the period from fiscal year 2018 through fiscal year 2020," the report said. "Moreover, while the probability of maintaining an 18-satellite constellation would remain relatively high, it would still fall below 95 percent for about a year over this period."

Also magnifying the findings was the June 16 Air Force announcement of an extended early orbit checkout procedure for a GPS block IIR-M satellite launched about three months earlier. Ground monitoring stations detected signal distortions, and specialists continued investigating their cause and effects during the checkout. The satellite notably carries a demonstration transmitter for testing the new L5 signal scheduled to be available from every GPS block IIF and subsequent satellite launched from late 2009 onward. The satellite's interface to the transmitter — not the transmitter's underlying technology — appeared to be the source of the problem, the Air Force said, and the satellite was expected to be switched to healthy status for global use around October 2009.

These issues come in the wake of several technical studies about five years ago that have helped the commercial air transport industry prepare for loss of GPS service integrity due to momentary, serious or severe disruptions/outages — ranging from the Air Force temporarily taking a faulty satellite off-line for maintenance to intentional signal jamming. Extensive recommendations have been published on flight crew and air traffic control (ATC) procedures and training; preflight use of publicly accessible GPS outage-prediction/reporting systems, including GPS/wide area augmentation system (WAAS) notices to airmen in the United States; external monitoring and on-board receiver autonomous integrity monitoring; immediate alerts to pilots when navigation anomalies are detected; GPS backup by an inertial reference unit–flight management computer updated by distance measuring equipment; use of raw data from navigation aids on the ground; ATC radar vectors; and redundancy afforded by GPS augmentation systems. Such anticipation prepares flight crews and ATC to assess the relative severity of any GPS service loss and its safety implications, and to act appropriately to protect their operations.[3]

GAO auditors studied the continuing transition from GPS II — in which the final replacements launched in 2009–2013 will have block IIR-M or the newer block IIF levels of technology (Table 1, p. 14) — and GPS III, for which the first satellites will have the block IIIA level of technology. The transition gradually will add several signals that upgrade performance, accuracy and integrity, and provide stronger defenses against jamming of military and civil GPS signals.

U.S. policy-makers and the Air Force responded to the resulting public concerns: "The U.S. Air Force launches additional satellites that function as active spares to accommodate periodic satellite maintenance downtime and assure the availability of at least 24 operating satellites," said the Space-based Positioning, Navigation and Timing National Executive Committee, the federal inter-departmental organization that sets national policy for GPS. "As of May 27, 2009, there were 34 satellites in the GPS constellation, with 30 set [by the Air Force as] 'healthy' to users."[4]

Air Force Reassurance

In late May, the Air Force stressed that the timely replenishment issue has received high priority. The Air Force Space Command "acknowledged the potential for an availability gap years ago, and has actively pursued and institutionalized procedures and processes to mitigate the potential gap

GPS Satellite Modernization

Legacy generation, 1989–2002	Current generation, 2005–2012		Future generation, 2014-2023
GPS IIA/IIR satellites	GPS IIR-M satellites	GPS IIF satellites	GPS III satellites
This generation of satellites had broadcast one encrypted signal for military users and one free non-encrypted signal (L1) for civil users.	The last of these eight satellites include IIA and IIR capabilities and, by the end of 2009, will have added to the GPS II constellation: • a second civil signal (L2C); • a second military signal; and, • the ability to increase signal power to improve resistance to jamming.	When launched beginning in late 2009, these 12 satellites will include IIR-M capabilities and add a third civil signal (L5) meeting enhanced requirements for transportation safety-of-life and integrity.	When launched in 2014, these satellites will include IIF capabilities and add: • in Block IIIA, a stronger military signal to improve jamming resistance and a fourth civil signal (L1C) that is interoperable with non-U.S. signals, such as Europe's Galileo satellite constellation; • in block IIIB, near real-time military command and control via cross links; and, • in block IIIC, improved anti-jam performance for military users.

GPS = global positioning system

Note: This table omits corresponding modernization stages of the GPS ground control segment. As of September 2008, the U.S. government had committed to furnishing civil users worldwide a free standard positioning service based on 24 primary slots with signal in space performance measurable as 95 percent or higher probability of 24 healthy satellites, 98 percent or higher probability of 21 healthy satellites and 99.999 percent probability of 20 healthy satellites.

Sources: U.S. Government Accountability Office; U.S. Space-based Positioning, Navigation and Timing National Executive Committee

Table 1

or minimize any impact," the Air Force said.[5] These processes were designed to "extend the life of on-orbit assets and to ensure GPS capability is delivered in a timely manner," according to Lt. Gen. Tom Sheridan, commander of the Space and Missile Systems Center, the acquisitions arm for the space command. "New acquisition approaches, including phased acquisition and prototyping, will reduce risk to constellation sustainment in the future," he said.

The Air Force noted that the seventh of eight block IIR-M GPS satellites was launched in March 2009, and that the space command expects to launch the last of that series in August 2009. Around the same time, early in fiscal year 2010, the space command has scheduled the launch of the first of 12 block IIF satellites.

The Air Force also sought to reassure civilian GPS users that all PNT services would be treated as a critical component of national infrastructure. "I have high confidence we will continue to sustain at least the 24 satellites required to maintain our current performance standard," said Gen. C. Robert Kehler, commander, Air Force Space Command. "The Air Force has been a good GPS steward continually providing 'better than expected' service to our GPS users. At this point, we foresee no significant loss of service in the future, near or far."

The GAO report acknowledged similar views conveyed by the Air Force and the acceptable status so far of GPS III development work. "At present, the GPS IIIA program is on schedule and program officials contend that there is no reason to assume that a delay is likely to occur," the report said. "They point out that the Air Force is implementing an incremental development approach and GPS IIIA, the first increment of GPS III, is not expected to be as technically challenging as other space programs."[6]

Problems keeping on schedule in manufacturing satellites have included changes of contractors and, on the military side, technical difficulties with block IIF, the report said. All satellites since December 2006 have been launched by United Launch Alliance, a joint venture combining the Delta and Atlas rocket programs of Boeing and Lockheed Martin, respectively; capacity to launch satellites was not an issue in the report. Assuming that the IIF program meets the current schedule, however, launch of the first satellite in that series will be three years behind schedule. Another principal concern was that plans for GPS IIIA call for a launch rate three times faster than was used for GPS IIR-M.

Some GPS IIF satellite-production delays were attributable to unsuccessful Air Force contracting reform efforts, technical problems, parts obsolescence and inefficiencies detailed in the report. Another problem cited was adding

U.S. Federal Aviation Administration

requirements — specifically, new military and civil signals, and flexible power capabilities — necessitating satellite design changes after the contractor had begun its work. "Procurement of additional GPS IIF satellites does not appear to be feasible" if significant satellite-replenishment delays actually occur, the report added.

Related concerns were the nine-month delay initiating GPS IIIA satellite acquisition, in May 2008, and reallocation of funding from the GPS IIIA program to other military uses. "GAO's analysis found that [the GPS III] schedule is optimistic, given the program's late start, past trends in space acquisitions and challenges facing the new contractor," the report said.

Unclear Potential Effects

Because civil aviation operations under instrument flight rules generally require augmented GPS signals, solutions to hypothetical GPS coverage gaps already may exist for some operators, depending on the avionics carried and other factors. "For example, many applications using augmentations such as satellite-based augmentation systems (SBAS), which in the United States is [WAAS], have increased tolerance to degraded accuracy and availability when the constellation may be operating at minimum committed levels of availability," the report said. "While a smaller GPS constellation could result in a significant reduction in positioning and navigation accuracy at certain times and locations, these times and locations are usually predictable in near-real time." In other cases, "intercontinental commercial flights use predicted satellite geometry over their planned navigation route, and may have to delay, cancel or reroute flights," the report added. "Because there are currently 31 [now 34] operational GPS satellites of various blocks, the near-term probability of maintaining a constellation of at least 24 operational satellites remains well above 95 percent."

The report encouraged system-user attention to these issues while identification of potential effects on civil aviation continues this year. "The impacts to both military and civil users of a smaller constellation are difficult to precisely predict," the report said. "For example, a nominal 24-satellite constellation with 21 of its satellites broadcasting a healthy standard positioning service signal would continue to satisfy the availability standard for good user-to-constellation geometry articulated in the standard positioning service performance standard. … In general, users with more demanding requirements for precise location solutions will likely be more impacted than other users."

Looking at worst-cases scenarios, GAO auditors were advised by Air Force specialists that another possible step would be to actively manage satellite systems, shutting down some subsystems to prolong the serviceability of others when aging solar-panel arrays no longer can produce adequate electrical power.

Actions So Far

A key GAO recommendation was that the U.S. defense secretary "appoint a single authority to oversee the development of the GPS system, including DoD space, ground control and user equipment assets, to ensure that the program is well executed and resourced and that potential disruptions are minimized." The DoD concurred and explained how this change has been implemented.

The Air Force said in the report that corrective measures have been implemented in the block IIF program: "Using incremental or block development, where the program would follow an evolutionary path toward meeting

In March 2009, the U.S. Air Force tested transmission of the new L5 signal from a GPS block IIR-M satellite, illustrated above. Below, USAF Tech. Sgt. Randall Thomas, right, of the 1st Space Launch Squadron, monitors pre-launch mating of the actual satellite to the Delta II rocket.

U.S. Air Force

needs rather than attempting to satisfy all needs in a single step; using military standards for satellite quality; conducting multiple design reviews, with the contractor being held to military standards and deliverables during each review; exercising more government oversight and interaction with the contractor and spending more time at the contractor's site; and using an improved risk management process, where the government is an integral part of the process."

To prevent similar problems in the block IIIA program, the Air Force said in the report that measures would include "re-evaluating the contractor incentive/award fee approach; providing a commitment from the Air Force to fully fund GPS IIIA in Program Objectives Memorandum 2010; funding and executing recommended mitigation measures to address the next-generation operational control segment and the GPS IIIA satellites; combining the existing and new ground control segment levels of effort into a single level of effort, giving the Air Force greater flexibility to manage these efforts; not allowing the program manager to adjust the GPS IIIA program scope to meet increased or accelerated technical specifications, system requirements or system performance; and conducting an independent technology readiness assessment of the contractor design once the preliminary design review is complete."

Mutual Support

Although the United States seeks to remain the leading provider of global navigation satellite services,[7] interoperability with new counterparts under development in Europe and Asia will be important from the standpoint of international relations and redundancy of some signals. "For civil and commercial users, one possible impact of a smaller GPS constellation could be an increased use of other PNT services, including those expected to be offered through Europe's Galileo system by the middle of the next decade," the report said.

However, the U.S. Department of State voiced its own concerns about insufficient U.S. technical experts assigned to activities to promote compatibility and interoperability of PNT systems under cooperative arrangements with Australia's ground-based regional augmentation system and ground-based augmentation system; India's GPS-aided and GEO-augmented navigation (GAGAN); Japan's multi-functional transport satellite–based satellite augmentation system (MSAS) and quasi-zenith satellite system (QZSS); and Russia's global navigation satellite system (GLONASS). The only legally binding executive agreement to date covers joint work with the European Union's Galileo program.[8]

"Without these resources, officials are concerned that it may be difficult to continue to ensure the compatibility and interoperability of [non-U.S.] systems," the report said. "It takes [U.S.] industry 18 to 24 months to develop a market-ready [Galileo] receiver, and the first operational Galileo satellite is scheduled for launch in 2010."

Notes

1. GAO. "Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities." Report to the Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, House of Representatives. Report no. GAO-09-325. April 30, 2009.
2. Chaplain, Cristina T. "Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities." Testimony before the Subcommittee on National Security and Foreign Affairs, Committee on Oversight and Government Reform, House of Representatives. GAO. Report no. GAO-09-670T. May 7, 2009.
3. FSF Editorial Staff. "Vulnerabilities Warrant Attention as Satellite-based Navigation Grows." *Flight Safety Digest* Volume 23 (December 2004).
4. U.S. National Executive Committee for Space-based Positioning, Navigation and Timing. "Frequently Asked Questions." <pnt.gov/public/fq.shtml>. June 2009.
5. U.S. Air Force. "AFSPC Exceeds Global Positioning System (GPS) Standard." News release by Air Force Space Command, Peterson Air Force Base, Colorado. Release no. 050509, May 22, 2009. <www.afspc.af.mil/news/story.asp?id=123150739>
6. The incremental approach emphasizes on-schedule performance through strategies that would include postponing work on some block IIIA GPS civil subsystems, including the distress alerting satellite system (DASS) payload, already delayed more than five years. DASS will be used to receive emergency locater beacon signals identifying the precise position of an aircraft, ship, vehicle or person in distress for immediate use by rescue coordination centers worldwide.
7. The Office of Space and Advanced Technology (OES/SAT) of the U.S. Department of State said, "Currently, OES/SAT is coordinating a broad diplomatic effort to encourage acceptance of [GPS] as a worldwide standard for satellite-based navigation." <www.state.gov/g/oes/sat> June 2009.
8. Although not mentioned in the GAO report, China has begun to build — based on its three-satellite COMPASS/Beidou Navigation Test System — a new constellation and ground control segment with global coverage, according to the United Nations International Committee on Global Navigation Satellite Systems <www.unoosa.org/oosa/SAP/gnss/icg/providers-forum.html>.

Major Donation
FROM A FORMER EMPLOYEE

Flight Safety Foundation has received a major gift from S. Harry Robertson — who, as an FSF employee in the 1960s, developed a flexible, puncture-resistant aircraft fuel tank housed inside a rigid structure — and Robertson's family.

The family donated $1 million, to be utilized by Flight Safety Foundation for future technical programs.

"We have no greater believer in the Foundation than Harry Robertson," said Edward W. Stimpson, chairman of the Foundation's Board of Governors, noting that Robertson has spent most of his career studying injuries caused by aviation crashes and searching for measures to prevent them. "He started his career with [Foundation founder] Jerry Lederer."

Robertson began working for the Foundation in 1961, after his graduation from Arizona State University and a four-year stint as a U.S. Air Force pilot. He joined the Foundation's Aviation Crash Injury Research (AvCIR) division, which conducted crash tests as part of its efforts to develop safer aircraft and aircraft components.

AvCIR — renamed later in the '60s as the Aviation Safety and Engineering Research (AvSER) division, in part to reflect its expanding focus but also, Robertson said, to make it sound "less scary" to the public — had a contract with the U.S. Army to develop denser fuels that would be less likely to vaporize and ignite after an accident. Although that effort did not succeed, another project involved tests of Robertson's concepts for a fuel tank designed to shield fuel from potential ignition sources. Ultimately, his fuel system was adopted for use by U.S. military helicopters and has been credited with reducing the number and severity of helicopter post-crash fires.

Later, Robertson founded Robertson Research Group and Robertson Aviation, which research, develop and produce crashworthy extended range fuel systems that feature self-sealing breakaway valves, frangible fasteners, and puncture- and tear-resistant bladders. Robertson remains president and CEO of Robertson Research Group; he has retired from Robertson Aviation, which continues his work on enhancing the crash-resistant qualities of helicopter fuel tanks.

S. Harry Robertson meets with FSF officials. From left, Joan Sullivan Garrett, vice chairwoman of the FSF Board of Governors; FSF President and CEO William R. Voss; Robertson; and FSF Chairman Edward W. Stimpson. In photo at right, Robertson, left, greets Stimpson.

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Sampling the Aggregate

First annual C-FOQA report provides benchmarks for corporate aircraft operators.

BY MARK LACAGNINA

Aviation departments participating in the Flight Safety Foundation corporate flight operational quality assurance (C-FOQA) program have received their first annual report, which is based on aggregate data and focuses on five key areas: unstable approaches, exceedance of aircraft limitations, maintenance events, flight operations events and landing performance.[1] The report provides a fleetwide yardstick that individual operators can use to measure their own results, as presented in separate reports tailored to each participant.

The annual report is based on analyses of aggregate data gathered during the 6,614 flights and 13,814 flight hours logged by the participants from 2006 through 2008 (Figure 1). "Not much compared with the longstanding airline FOQA experience, but enough to begin seeing some patterns," said William R. Voss, FSF president and CEO.[2] "Like most changes in aviation, it takes time, but we are starting to build and aggregate data in the business aviation industry."

The Foundation's Corporate Aviation Committee and the National Business Aviation Association's Safety Committee pioneered C-FOQA in 2004. The goal is to provide corporate aircraft operators the safety measurement tools that the airlines have been using for many years. About 100 airlines worldwide currently have flight data monitoring programs designed to collect and analyze recorded flight data to detect unsafe procedures or events early enough to allow timely intervention to avoid accidents and incidents.

Two corporate aircraft operators were enrolled when the C-FOQA program was launched in 2006 following a successful demonstration project. As of the end of 2008, nine corporate aircraft operators were participating. The C-FOQA fleet currently comprises 24 aircraft, some of the same model, including the Bombardier Challenger and Global Express, Dassault Falcon 900 and 7X, Embraer 135, and Gulfstream IV, V, 450 and 550.

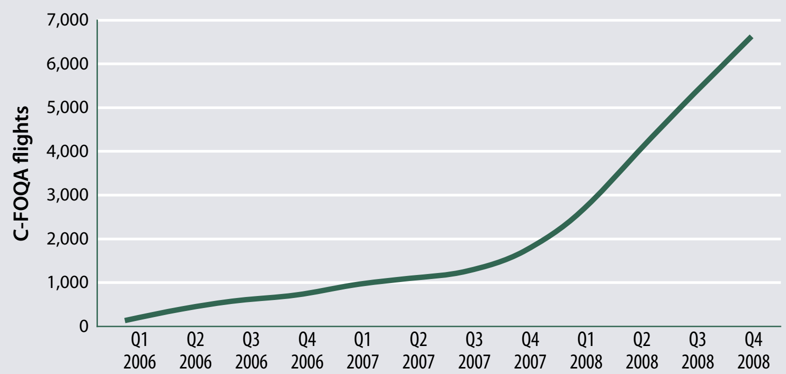
As a natural follow-up to the Foundation's work in approach and landing accident reduction, the primary focus of C-FOQA data analysis is identifying unstable approaches and their causes. The report shows that about 8 percent of the 6,614 flights in 2006–2008 involved unstable approaches (Figure 2).

The report includes the rates of unstable approaches that occurred seasonally, quarterly and yearly during the period. The highest rates of unstable approaches occurred in the second and third quarters of each year — April through September — with 10.0 percent and 9.4 percent, respectively. The unstable approach rates for the first and fourth quarters were 6.0 percent and 6.4 percent, respectively.

A breakdown of the C-FOQA data indicates that the leading cause of unstable approaches in 2008 was a high rate of descent on final approach. High descent rates were identified in 66 of the unstable approaches (Figure 3, p. 20). Fifty of the approaches were designated as *caution events* and 16 as *warning events*. These designations stem from the Foundation's development of *standard event limits* to guide the data processing and analysis conducted chiefly by Austin Digital, which provides similar highly automated services for numerous airlines with flight data monitoring programs.

The report provides information about the standard event limit parameters that were established for unstable approaches. For example, for the analysis of recorded descent rate on final approach, the Foundation established maximum descent rates — or limits — for altitudes below 500 ft HAT (height above touchdown) — that is, 500 ft above the runway touchdown zone elevation. The limits range from 1,800 fpm at 500 ft HAT to 1,200 fpm near touchdown.

C-FOQA Flights by Quarter, 2006–2008

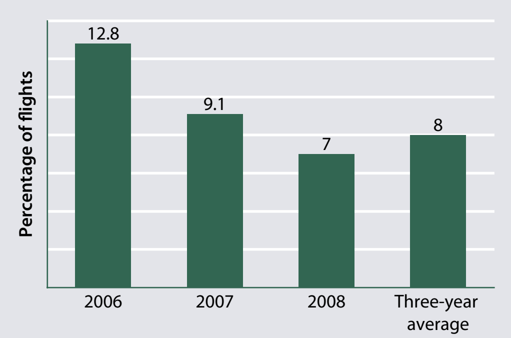


Q = quarter

Source: Flight Safety Foundation

Figure 1

Unstable Approach Event Rates



Source: Flight Safety Foundation

Figure 2

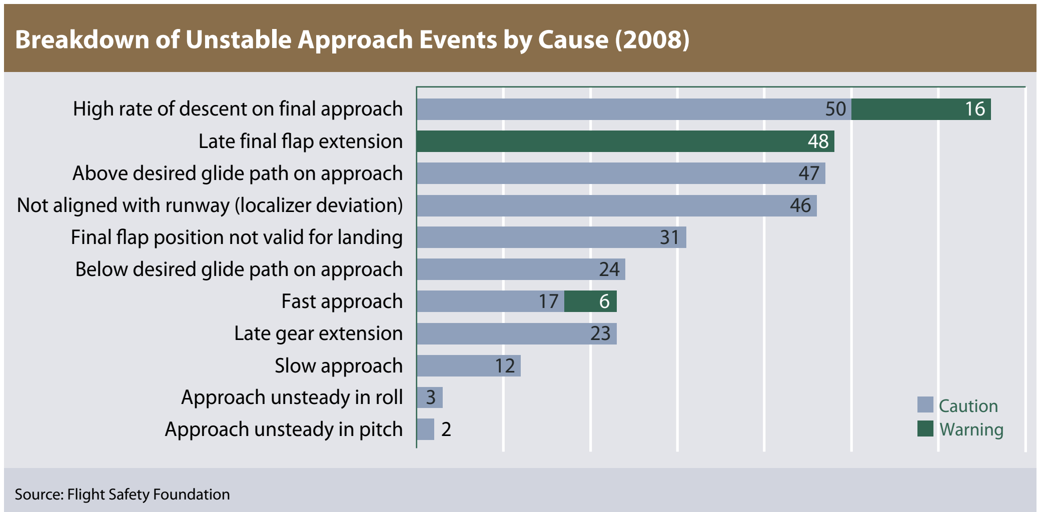


Figure 3

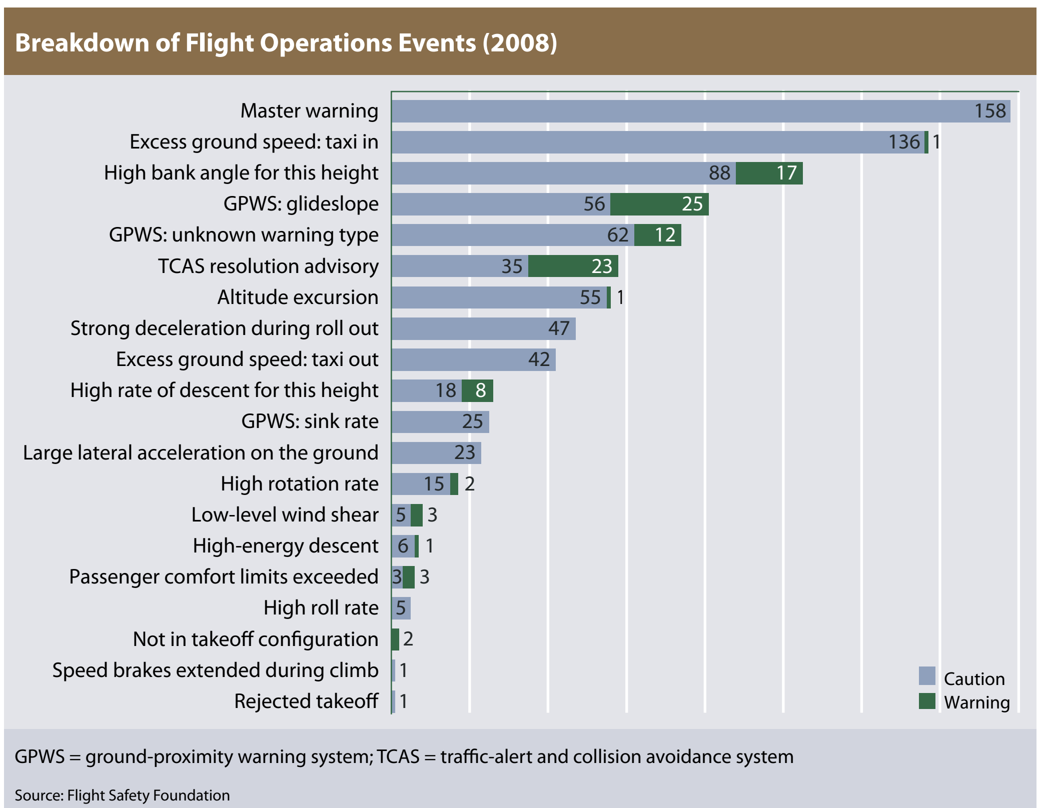


Figure 4

During data analysis, descent rates that exceed the limits are flagged. The standard event limits in this case define the severity of an event based on the percentage by which the descent rate exceeds a limit. Exceedances up to 10 percent beyond the limits are identified as caution events, and those greater than 10 percent are identified as warning events.

The report shows that the second most prominent cause of unstable approaches in 2008 was late extension of flaps to the landing configuration, which occurred during 48 approaches. The Foundation established only a warning limit for this critical procedure: If the recorded data show that the final flap selection was made below 500 ft HAT, the approach is flagged as a warning event.

Deviations from the glideslope and localizer during instrument landing system approaches also were found to be significant causes of unstable approaches. The caution limits are a deviation of two "dots" above the glideslope, as indicated by the horizontal situation indicator, a deviation of one dot from the localizer and any deviation below the glideslope between 500 ft HAT and 200 ft HAT. Among the unstable approaches involving these deviations were 47 that strayed above the glideslope limit, 46 that exceeded the localizer limit and 24 that went below the glideslope limit.

Selection of a final flap setting that was not appropriate for landing was the cause of 31 unstable approaches. Excessive airspeed was the destabilizing factor in 23 approaches, including 17 caution events, in which airspeed exceeded VAPP, the target approach speed, by more than 20 kt, and six warning events, in which airspeed exceeded VAPP by more than 25 kt.

Late extension of the landing gear was the cause of 23 additional unstable approaches. All were caution events, cases in which the gear was extended between 1,000 ft HAT and 500 ft HAT. (Gear extension below 500 ft HAT is a warning event.)

Twelve approaches were destabilized by airspeeds that deviated below Vapp. All were caution events, in which the recorded airspeeds were no more than 10 kt below the target.

Three of the unstable approaches were "unsteady in roll," with recorded roll rates exceeding 4 degrees per second; and two approaches were "unsteady in pitch," with pitch rates exceeding 1.5 degrees per second.

The report showed that few of the 28 tracked aircraft operating and performance limitations were exceeded in 2008. However, there was a surprisingly high number of events involving one limitation, the maximum flap-extension speed. The report showed that there were 59 exceedances, all of which were labeled as caution events.

The aggregate data also revealed three caution events in which airspeed exceeded the Mach limit, two caution events involving exceedance of the maximum landing gear extension speed and single caution events involving airspeed near stall speed and exceedance of the landing weight limit. There was one warning event that involved fuel temperature that apparently dropped far below the published limit, greatly increasing the risk of fuel icing.

The C-FOQA data for 2008 also were gleaned for 14 different events that could result in the need for nonroutine maintenance. The use of thrust reversers at slow speeds stood out with 104 caution events. The contribution of reverse thrust to stopping performance on a dry runway decreases substantially at airspeeds below about 80 kt and drops to zero at about 60 kt while increasing the risk of foreign object damage and compressor stalls, both of which are maintenance issues.[3]

Hard landings were involved in 33 maintenance events, one of which was designated as a warning event. Also among the warning events were two cockpit warnings of smoke, an engine fire, an engine compressor stall and one incident in which an aircraft was airborne with its thrust reversers not stowed. Low hydraulic pressure caused one caution maintenance event.

Master Warnings

Nearly 18 percent of the flights monitored by C-FOQA from 2006 through 2008 encountered flight operations events (Figure 4). The rate was fairly constant each year. Master warnings were the most frequent flight operations event recorded in 2008, with 158, followed by excessive groundspeed while taxiing in after landing, with 137, including one designated as a warning event. Excessive bank angles at low altitude were recorded during 105 flights, with 17 designated as warning events.

There were 81 ground-proximity warning system (GPWS) "glideslope" warnings, of which 25 were designated as warning events. Unknown types of GPWS warnings followed with 62 caution events and 12 warning events. Traffic alert and collision avoidance system (TCAS) resolution advisories were recorded during 58 flights, with 23 designated as warning events. There were 56 altitude excursions, including one warning event. Strong decelerations during rollout were recorded during 47 landings, and excessive groundspeeds while taxiing out for departure were flagged in 42 caution events. High descent rates at low altitude were tagged in 18 caution events and eight warning events.

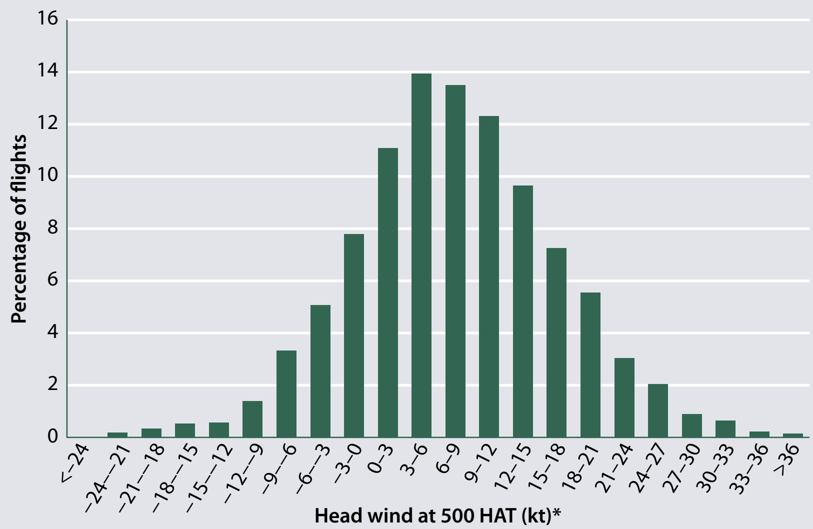
GPWS "sink rate" warnings were recorded during 25 flights, and large lateral accelerations on the ground were recorded during 23 flights. Other flight operations events included high rotation rates (17, with two warning events), low-level wind shear (eight, including three warning events), high-energy descents (seven, with one warning event), exceeding passenger-comfort limits (three caution events and three warning events), high roll rates (five), and improper takeoff configuration (two warning events). One caution event involved speed brakes that deployed during climb. Another involved a rejected takeoff.

An important point is that further analysis by the operator could shed a different light on the findings. For example, an event involving "improper takeoff configuration" might have resulted from the flight crew's proper selection of a nonstandard flap setting for departure from a high-density-altitude airport.

The report provides various analyses of landing performance data recorded during 2008. Presented as distributions from the mean, the analyses include factors such as wind components encountered at 500 ft HAT, airspeeds and the distances from runway approach thresholds and runway distances remaining on touchdown. Figure 5 (p. 22) is an example. A close look at the distribution of wind components shows that a fairly high number of approaches — nearly 20 percent — actually were conducted with tail winds. The tail wind component during nearly 3 percent — or 147 — of the 4,901 approaches conducted last year was 10 kt or more.

The annual C-FOQA report provides not only a glimpse of trends found in the aggregated data but also a benchmark that individual operators can use to compare their own results. Tailored quarterly and annual reports are generated for each operator enrolled in the program. Figure 6 (p. 22) is an example

Distribution of Head Wind on Approach (2008)



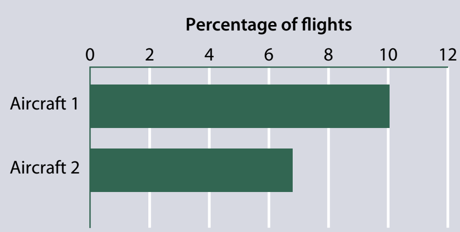
HAT = height above touchdown

*Negative values represent tail wind

Source: Flight Safety Foundation

Figure 5

Unstable Approach: Breakdown by Aircraft



	Number of Flights	Number of Unstable Approaches	Percent Totals
Aircraft 1	388	39	10.05%
Aircraft 2	338	23	6.80%
Total	726	62	8.54%

Source: Flight Safety Foundation

Figure 6

of what an operator might see in its own report. The breakdown shows that the rate of unstable approaches for one of the operator's airplanes was substantially higher than the other airplane and, compared with the information provided in the annual report, was higher than the 8 percent average rate for the C-FOQA fleet. Similar presentations in the individual operator's quarterly and annual reports would show the number and rate of unstable approaches that occurred at the specific airports used by the operator, facilitating its search for precursors and development of strategies to avoid them.

The first annual C-FOQA fleet report was well received. "From talking with the operators, I think they were pleased with the annual report and found it to be beneficial," said Edward D. "Ted" Mendenhall, coordinator of the C-FOQA program and a member of the Foundation's Corporate Advisory Committee. "Each one of them also received an annual report for their own operation and saw how they compared with all of the participants in the C-FOQA program."

A users' meeting was scheduled to be conducted near Teterboro, New Jersey, on June 23-24 to enable the participating operators to discuss the annual report with Foundation staff and to identify ways in which the data collection, analysis and presentation can be improved to meet their needs.

Confidentiality is a cornerstone of the program. "One of the things we have worked very hard to do is to protect the identity of the operators," Mendenhall said. "So, we have to be very careful about any changes we make and with the data we publish."

As participation in the C-FOQA program grows, more data will be gathered, and the new window to operational safety and efficiency will open further.[4] "The program really is in its infancy, and we have just begun to build a database that can be queried at any time to help analyze trends," Mendenhall said. "We are seeing increased interest from corporate aircraft operators."

Notes

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Ground Check

Auditors have completed nearly 50 of IATA's safety audits for ground service providers, aimed at dramatically reducing the costs of ground damage.

BY LINDA WERFELMAN

The International Air Transport Association (IATA), whose safety audits have become a staple for operators worldwide, is extending the practice to ground operations with implementation of the IATA Safety Audit for Ground Operators (ISAGO).

The first ISAGO audits were conducted in 2008, and by May 2009, 48 had been completed, said Günther Matschnigg, IATA senior vice president for safety, operations and infrastructure. By October, about 100 audits will have been completed, and the results then will be analyzed to determine industrywide trends, Matschnigg said.

"With each audit, we learn something," he said. Nevertheless, before trends can be identified, "we need to have quite a good array of information."

IATA has described safety as the top priority of the ISAGO program, and ISAGO audits have two purposes: to reduce the number of redundant audits performed by airlines on their ground service providers and, ultimately, to reduce ground damage to aircraft, Matschnigg said.

Beginnings

The ISAGO program is a product of IATA's Ground Damage Prevention Program, which was begun in 2005 with a goal of halving the annual cost of ground damage — estimated at $4 billion for the airline industry, plus an additional $1 billion for corporate aircraft operators — by 2010. In 2008, ground damage was estimated to have been responsible for 17 percent of aviation accidents.

IATA describes the ISAGO program as "an audit system conducted in a standardized and consistent manner, using internationally recognized quality auditing principles." In comparison, the audits conducted before the advent of ISAGO typically had different standards, and there was little sharing of audit information.

Because ground service providers perform diverse activities ranging from passenger and baggage handling to load control and cargo handling, the ISAGO audit has been "built upon a backbone of audit standards applicable to all ground handling companies worldwide," IATA says.[1]

"It's clear we have created something the industry needs and values," Mike O'Brien, the director of the ISAGO program, said in an IATA publication. "For the first time, we have a common set of globally applicable operating standards for ground handlers, coupled with an audit program to assess conformity with those standards."[2]

The audits are conducted at both the headquarters of ground service providers and at their airport stations. Headquarters audits focus on operational management and control and last about two to three days; station audits last one to two days.

Standards for the audits, published in the *ISAGO Standards Manual*,[3] are "specified systems, policies, programs, processes, procedures, plans, sets of measures, facilities, components, types of equipment or any other aspects of ground operations under the scope of ISAGO that are considered an operational necessity and with which a provider will be expected to be in conformity at the conclusion of the audit."

The manual also contains recommended practices considered "operationally desirable," although compliance is optional.

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Eight sections are included in the manual: "Organisation and Management System," "Station Management System," "Load Control," "Passenger Handling," "Baggage Handling," "Aircraft Handling and Loading," "Aircraft Ground Movement" and "Cargo and Mail Handling."

ISAGO's headquarters audits are performed by the organizations that conduct audits under the IATA Operational Safety Audit (IOSA) program, which was the model for ISAGO. Members of the ISAGO Audit Pool, consisting of auditors designated by participating airlines, perform station audits. The results of audits performed by members of the audit pool are shared by all participating airlines, eliminating the need for individual audits to be commissioned by each airline that uses the services of a particular ground service provider at a particular airport. In May, about three dozen airlines were members of the audit pool.

After a ground service provider has undergone an audit and accomplished all changes recommended by the auditor, the company is listed on the ISAGO Registry. IATA says the registration applies first to a ground service provider's headquarters; stations are incorporated into the registry individually, as subsequent audits show that they are in compliance with ISAGO standards.

In addition to audits, the ISAGO program also provides three-day training programs for ground service providers at locations around the world to acquaint them with ISAGO standards and recommended practices and help them prepare for an ISAGO audit.

IATA says that the overall benefits of the program — in addition to safer operations with fewer accidents and injuries — include reduced costs not only because of the reduction in accidents but also because of the elimination of redundant audits, improved safety oversight, harmonized standards and auditor training, and "enhanced understanding of high-risk areas within ground operations."[4]

Airport authorities and regulators also stand to benefit from ISAGO because of the improved oversight of ground service providers that the audit program will provide, IATA said.

Foundation Programs

Flight Safety Foundation began its related Ground Accident Prevention (GAP) program in 2003, after one of its airline members requested help in improving ramp safety to reduce injuries and damage.

Using data developed by IATA, the Foundation estimates that 27,000 accidents and incidents — one per 1,000 departures — occur every year on the ground at airports worldwide. These events cause about 243,000 injuries every year.[5]

When injury-related costs, such as medical treatment and other factors, are included, they boost the estimated price tag for airline-related ground damage from $4 billion a year to at least $10 billion worldwide, according to the Foundation.[6]

The GAP program's goals were the development of information, e-tools and other products to prevent accidents and incidents on airport ramps (aprons) and adjacent taxiways. The program also aimed to eliminate accidents during the movement of aircraft into and out of hangars, and during other operations.

Among the GAP e-tools developed by the Foundation are a model for calculating an operator's ground-damage-related costs; a series of "leadership tip sheets" — one-page briefings intended to enhance senior managers' awareness of ground safety problems and of the importance of a companywide safety management system; a three-part video about the towing of corporate/business aircraft; and a template that presents industry best practices and guidelines to help operators develop standard operating procedures for addressing an array of ramp operations. Subjects include positioning ground service equipment, preventing foreign object damage, selecting protective clothing and equipment, loading and unloading cargo aircraft, using hand signals, handling dangerous goods, and moving an empty aircraft.

Notes

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Making IS-BAO More Robust

The standard, good as it is, could be made better by addressing the risks of outsourcing.

BY SUSHANT DEB

In the recent past, the aviation world has observed a significant growth in business aviation.

In response, and in recognition of a worldwide need for an international business operations standard, the International Business Aviation Council (IBAC) developed the International Standard for Business Aircraft Operations (IS-BAO), adopting some of the quality management system (QMS)–related principles inherent in the International Organization for Standardization (ISO) 9001:2000 standard.

The adoption of the safety management system (SMS) concept tied to risk analysis (RA) is what makes the IS-BAO standard sensible and appropriate. The IS-BAO standard was created before the International Air Transport Association's (IATA's) Operational Safety Audit (IOSA) standard as well as the International Civil Aviation Organization (ICAO) AVSEC (aviation security) standard. Today, implementation of IS-BAO by operators complies with, or meets the spirit of, regulatory requirements of many civil aviation authorities.

The IS-BAO standard requires implementation of an SMS, which contains many of the key clauses of the ISO 9001:2000 QMS.[1] Furthermore, within the SMS, the call for RA makes the IS-BAO standard robust. The reason is clear: Since the goal of an SMS is to manage safety risks, it means that SMS must be proactive; and to have a management system proactive, we need to apply the well-accepted P-D-C-A (plan, do, check, and act) approach, which is also the basis of the ISO 9001 standard.

Safety is enhanced by identifying and assessing the hazards and associated safety risks that are ever-present in aviation operations. The IBAC publication *Guidelines for the Conduct of Risk Analyses by Business Aircraft Operators* provides additional guidance on conducting RA, such as identifying accident scenarios and the associated hazards; severity and likelihood of safety risk determination; hazard and risk management decisions; and documenting the information for traceability and assessment of results. This document provides a valuable instruction for business aviation operators — ISO 9001 does not go that far — in two appendixes:

- Appendix A, *Forms & Checklists*, is in three parts — the RA Checklist that is used when planning and conducting an RA; an accident scenario form by events and hazards within each event; and a hazard sheet that for each hazard describes an event scenario, mitigation, severity category and likelihood.
- Appendix B, *Conducting a Hazard Analysis*, follows a standardized sequence of steps.
- Another IBAC publication, *Tools for Efficient SMS Design*, further strengthens the IS-BAO standard.

IS-BAO comes with acceptable means of compliance (AMCs) that help operators seeking certification. These are not procedures or work instructions in the ISO sense; however, the AMCs can be helpful for operators developing their own procedures or work instructions. The compliance with AMCs is not mandatory.

The AMCs are in line with a few of the eight quality management principles identified in ISO 9004:2000, which form the basis of the ISO 9001 standard. These are:

- *Factual approach to decision making*: Effective decisions are based on analysis of data and information, and organizations need a system of collecting and documenting such data. Documentation can help a business aviation operator to manage planning, operations and control of its safety and quality service processes.
- *Systems approach to management*: This involves identifying, understanding and managing a system of interrelated processes for given objectives that improves the business aviation operator's safety effectiveness. The system approach specified by IS-BAO mandates some form of review conducted at regular intervals by top management.
- *Continual improvement*: The primary purpose is to institute an internal evaluation program that would serve as a "feedback" system. The implication is that, by knowing what and how well the operator does in that area, it is possible to identify ways to continually improve the business aviation operator's safety and quality initiatives.

IS-BAO is a well-designed standard at the macro level. However, further improvements in the standard are possible at the micro level. IS-BAO is based on 14 protocols, with subsets in each protocol called elements. The standard uses "shall" and "must" to indicate a required element, and "should" to indicate a recommended practice. The protocols are shown in Table 1.

This standard mandates that safety will not be compromised by the business aircraft operators under any circumstances. They are in a service business, and customer satisfaction is a quality objective that is integral with their safety objectives. Thus, *safety is the most important operating rule for business aircraft operators.*

IS-BAO Protocols
Safety Management System
Organization and Personnel Requirements
Training and Proficiency
Flight Operations (Domestic)
Flight Operations (International)
Aircraft Equipment Requirements
Aircraft Maintenance Requirements
Company Operations Manual
Emergency Response Plan
Environmental Management
Occupational Health and Safety
Transportation of Dangerous Goods
Security

Source: Sushant Deb

Table 1

This all-important operating rule becomes "vulnerable" for almost all operators, because none of these operators are vertically or horizontally integrated with the sources of supplies they need to operate. For example, their maintenance departments purchase parts and materials from suppliers within the industry. Many operators use outsourced services such as calibration, preventive maintenance and training, as the operators do not have in-house expertise in these areas.

These are common processes within business aircraft operations. IS-BAO must address these processes because they affect the safety operating rule directly. One of the eight management principles on which the ISO 9001 is based states:

"*Mutually Beneficial Supplier Relationships:* An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value."

After all, the foundation of IS-BAO is the identification of processes needed for the SMS and the application of these processes throughout the operations; determining the sequence and interaction of these processes; ensuring the availability of resources to support the safety objectives; and implementing actions necessary to achieve planned safety results. Implementation of this management principle from the ISO 9001 standard will enhance operational safety.

Indeed, the above management principle can be incorporated within the operator's operations manual (Protocol 10) under a new element. For example, within Protocol 10 of IS-BAO, a new element could be called Purchasing Process, to include the following suggested sample checklist questions as sub-elements:

10.X. Purchasing Process.

10.X.1. Does the operator ensure that a purchased product conforms to specified purchase requirements?

10.X.2. What type of control is applied to the supplier and to what extent?

10.X.3. Does the operator evaluate and select suppliers based on their ability to supply products in accordance with the operator's requirements?

10.X.4. Are the criteria for selection and evaluation established by the operator?

10.X.5. Does the operator maintain a list of approved suppliers that includes the scope of the approval?

10.X.6. Has the operator established a supplier audit program? Does the operator maintain the records of such audits and follow through on any corrective action resolution process?

10.X.7. Do the operator's purchasing requirements accommodate supplier notification to operators of nonconforming products?

10.X.8. Do the operator's purchasing requirements include specific approval requirements?

10.X.9. Has the operator established receiving inspection or other activity necessary for ensuring that purchased product meets specified purchase requirements?

10.X.10. Do the operator's verification activities include obtaining objective evidence of the quality of the product from suppliers, such as accompanying documentations, certificate of conformity, test reports, etc.?

Since safety cannot be compromised under any circumstances, IS-BAO mandates the operator to be ultimately responsible for the quality of all products purchased from suppliers. Such probing will force the operator to take appropriate measures to prevent the purchase of counterfeit product. Another positive result would be the operator's purchasing process satisfying authority requirements related to the use of non-certificated suppliers.

Taking advantage of services from outside is common today in most business operations. The business aircraft operators are no exception. Business aircraft operators seeking IS-BAO certification should be required to address the management of "outsourced processes" in the company operations manual (Protocol 10).

An "outsourced process" is one that a business aircraft operator needs for its SMS and which the operator chooses to have performed by an external party. Ensuring control over outsourced processes does not absolve the operator of the responsibility of meeting customers' needs, such as schedule changes or the need for expanded service contracts, as well as statutory and regulatory requirements.

The following suggested sample checklist questions may be included as sub-elements within a new element called Outsourced Process, of Protocol 10 of the standard:

10.Y. Outsourced Process.

10.Y.1. Does the operator have contracts executed with external service providers?

10.Y.2. Do such contracts include metrics that can be monitored to ensure that requirements affecting the safety of operations are being met?

10.Y.3. Is the type and extent of control to be applied to the outsourced processes documented in the operator's SMS?

10.Y.4. Does the operator use audits to manage the outsourced processes?

10.Y.5. If the operator has "wet lease" type operations, does the operator have a monitoring process in place to meet the safety objectives of the operator?

Similar sample questions can be developed as elements in other IS-BAO components, such as Training and Proficiency (Protocol 5), Aircraft Maintenance Requirements (Protocol 9) and Security (Protocol 15), introducing elements related to outsourcing. At the same time, it should be recognized that the type and extent of control applied to the outsourced processes may be influenced by factors such as the potential impact of the outsourced processes on the operator's capability to provide services that conform to safety objectives, the degree to which the control for the processes is shared, and the capability to achieve necessary control through the application of the suggested purchasing process elements described in **10.X**.

Besides controlling the supply chain, Security (Protocol 15) may need additional elements to make this protocol robust. The acceptable means of compliance, AMC 15.0 in an IBAC publication titled *An International Standard for Business Aircraft Operators*, provides significant guidelines. In addition, two attachments, *Sample Security Checklist* and *NBAA Voluntary Security Protocol for Part 91 Operators* in the same AMC section, may be helpful to business aircraft operators seeking IS-BAO certification. Unfortunately, the AMCs are guidelines only. Operators are not required to comply unless requirements are actually included in the protocol as elements.

Again, sample checklist questions are suggested to be included as elements in the Security protocol of the IS-BAO:

15. Z.1. Does the operator have a management system in place for operational security?

15. Z.2. Has the operator appointed a security chief who has direct access to top management of appropriate authorities — for example, the U.S. Federal Aviation Administration (FAA), the U.S. Transportation Security Administration (TSA) if applicable and the local airport — as well as the security chief's own organization?

15. Z.3. Has the operator developed a security manual?

15. Z.4. Has the operator implemented a formal security program based on the security manual?

15. Z.5. Has the operator established a review process for security training programs?

15. Z.6. Does the operator ensure access control at airside areas of the airports at which it operates?

15. Z.7. Does the operator use general aviation airports that comply with the TSA's Security Guideline IP-001, Rev. 05/2004?

15. Z.8. Does the operator adhere to TSRs (Transportation Security Regulations), Title 49 CFR Part 1550 and/or Part 1544 or Part 1546?

15. Z.9. For international flights, does the operator conduct basic background checks of ground handling agents at destinations?

15. Z.10. Does the operator have a procedure for an aircraft security check at the point of origin (domestic and international)?

15. Z.11. Has the operator established procedures for carrying dangerous goods and weapons?

15. Z.12. Does the operator have a contingency plan in case of a security violation?

IS-BAO is a very practical standard. The requirements are not difficult to implement by any safety-conscious operator. The operator aspiring for achieving IS-BAO certification may have been already subjected to more rigorous FAA requirements if it is certified under U.S. Federal Aviation Regulations Part 135. The IS-BAO standard has been tested over the past six years and the business aviation operators all over the world who implemented this standard now have healthy safety and quality cultures in their organizations.

The suggested new elements in this article are examples only; the lists are not exhaustive. Currently, IS-BAO certified auditors may not be looking at the control of outsourced services, since that is not included in the IS-BAO Audit Procedures Manual. Incorporating additional elements will require auditors to look into those processes. Without control of suppliers and outsourced processes and without a comprehensive security program, operators — especially those at general aviation airports — may be exposing themselves to greater risk in their operations.

Sushant Deb <www.avsafe.aero> trains and consults on IOSA gap analysis, airport SMS audits and IS-BAO audits. He is a member of Flight Safety Foundation and the American Society for Quality.

Notes

1. ISO 9001:2008 was officially released on Nov. 15, 2008. There are no changes in clauses or elements, and no new requirements; however, clarifications and added responsibilities are explained for certain existing clauses. The term "ISO 9001 standard" is therefore used throughout this article.
2. "Operator" here refers to the business aircraft operator.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria VA 22314-1756 USA or donoghue@flightsafety.org.

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Correcting DEFICIENCIES

Improved training is needed for flight crews and maintenance personnel in the CIS in the aftermath of accidents involving human factors issues.

BY VLADIMIR KOFMAN

Despite years of accident-free operations for many leading airlines in the Commonwealth of Independent States (CIS) and generally positive assessments in recent safety audits,[1] immediate action is required to correct deficiencies involving the quality of training for flight crews and maintenance personnel.

In 2008, the 12 CIS countries — all party to the Agreement on Civil Aviation and Airspace Use, whose executive body is the Interstate Aviation Committee (MAK) — experienced 40 civil aircraft accidents, including 21 fatal accidents with 231 fatalities, in all types of air work. Of these, eight were transport aircraft accidents, including three fatal accidents that killed 161 people.

Worldwide, during 2008, 55 transport aircraft accidents occurred, including 22 fatal accidents that killed 514 people (p. 47).[2] The three fatal transport aircraft accidents in the CIS accounted for nearly 14 percent of the worldwide total; the 161 fatalities represented 31 percent of the total.

The causes of these accidents can be traced to repeated combinations of human factors issues involving flight and ground personnel and stemming from organizational problems at a number of airlines. This is an indication of serious system-based deficiencies in flight personnel training.

This situation damages civil aviation's reputation in the CIS and may result in the inclusion of some air carriers on the European


Susan Reed

Union's blacklist of unsafe airlines. As a result, complex measures are required to increase state support and stabilization of airline activities.

The primary problems in aviation safety in the CIS are the following:

- About half of air carriage is performed in aircraft manufactured in the Soviet Union from 1960 through 1970. Manufacturers' oversight is inadequate for continuing airworthiness and customer service for these aircraft.
- There is a shortage of spare parts, and delivery of available parts often is delayed.
- Because of the parts shortage and the accompanying delays, a "deferred defects system" has taken hold in which aircraft defects are not effectively monitored and an aircraft's flight capability period may be unreasonably prolonged. Some airlines have developed their own minimum equipment lists (MELs), even for domestically manufactured aircraft, and have not coordinated the MELs with aircraft design bureaus.
- The aircraft incident investigation process does not take into account the International Civil Aviation Organization's (ICAO's) standards, and incidents are not investigated with the same techniques used to investigate accidents.
- The system of aviation personnel training does not conform to present requirements. Flight crew training programs, including training under special flight conditions, have not been reviewed for the past 10 years. Implementation of conversion training programs in the airlines is not always adequately controlled.
- In 2008, during the course of aircraft accident investigations, deficiencies were found in the staffing of flight crews and their interaction with cabin crews.
- Because of the increasing use of Western-manufactured aircraft, the number of accidents involving these aircraft also is increasing. This is not only because of the increase in their operations but also because of the ineffectiveness of measures to prevent failures and defects in foreign-manufactured aircraft and their parts. In addition, there is no time to train the flight crews and ground personnel who operate these aircraft. Language proficiency also is a factor. Aircraft accident investigations have found that even in normal operating conditions, mistakes have been made because of the difficulty of maintaining an adequate vocabulary in a foreign language.[3] One solution might be to expand the existing electronic library of information on domestic aircraft to include Western-built aircraft.
- Some aviation-related laws have not been fully developed and adopted. Other documents are obsolete and have not been harmonized with international standards.
- Since 1992, the number of airports in the CIS has been significantly reduced. Some airports do not have paved runways, air navigation facilities or airport lighting equipment to meet ICAO standards. This affects not only the scheduling of flights but also directly threatens flight safety.
- In a number of regions, air navigation facilities do not meet the requirements of modern aircraft and do not provide accurate en route information.
- Since the 1990s, aviation meteorological services have deteriorated.

The CIS has supported ICAO efforts to develop regional and sub-regional interactions to improve aviation safety. These efforts require not only special knowledge in certain areas of aviation activity but also considerable financing, unification of resources and the experience of specialists.

CIS member states have consistently pursued a policy of deepening international cooperation in flight safety throughout MAK's 18-year history. MAK operates one of only seven scientific-technical centers in the world that have been identified by ICAO as capable of conducting the necessary work related to aircraft accident investigations and has conducted more than 400 investigations, including international cases, in 53 countries of the world.

With the U.S. National Transportation Safety Board (NTSB), MAK conducted 35 aircraft accident investigations that resulted in recommendations to improve the production technology of aircraft design composite elements, to develop new designs of aircraft control systems and to enhance standards of airworthiness.

Other joint aircraft accident investigations with France included unique activities in the Black Sea to retrieve the "black boxes" from the Armavia Airbus A320 that struck the water on May 3, 2006, after a rejected approach

to the airport in Sochi, Russia. All 113 people in the airplane were killed, and the airplane was destroyed.[4]

Cooperation and interaction have become standard. MAK forwards timely operational information on aircraft accident developments to aviation authorities in other states in the region on a confidential basis so that urgent preventive measures can be implemented.

To enhance flight safety, the following are necessary:

- Solve human factors problems — the main contributors to aircraft accidents and incidents in flight operations, air traffic management, air traffic control and other areas;
- Improve preparation for and performance of charter flights so that they equal the preparation and performance required for scheduled flights;
- Emphasize safety during flights in mountainous areas, and reduce instances of controlled flight into terrain;
- Maintain the continuing airworthiness of an aging aircraft fleet operated in different regions of the world; and,
- Increase the level of language proficiency for ground handling and flight operations personnel who service and operate Western-built aircraft.

Since 2001, under the framework of an ICAO–MAK project, practical assistance has been given to state aviation authorities in implementing the rules based on ICAO standards and recommended practices; training of inspectors and specialists of flight and engineering services (more than 3,500 specialists have been trained); holding conferences; and distributing flight and technical materials.

In particular, in early June, a Global Aviation Safety Roadmap Summit was held in Moscow to consider common issues of flight safety, to develop an action plan concerning urgent problems and to inform participants of the results of the meeting.

Among the topics discussed were the inconsistent use of safety management systems and the shortage of qualified personnel. The summit focused on informing participants about the Global Aviation Safety Roadmap and their role in the initiative and was an important new step in allowing governments and industry to identify and address the regional safety issues.

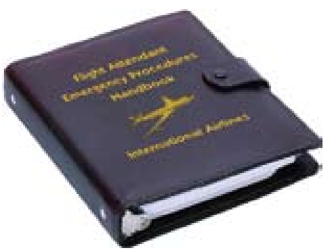
Vladimir Kofman, Ph.D., the former chairman of MAK's Aircraft Accident Investigation Commission, is the principal expert for air accident investigation.

Notes

1. The countries included in recent audits, in addition to Russia, are Armenia, Azerbaijan, Tajikistan, Ukraine and Uzbekistan. These six countries, along with six others — Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova and Turkmenistan — make up the CIS and are members of the Agreement on Civil Aviation and Airspace Use.
2. International Air Transport Association data show that the 55 fatal transport aircraft accidents in 2008 included 23 fatal accidents that killed 502 people.
3. ICAO has established a 2011 deadline for international compliance with English language proficiency requirements for pilots and air traffic controllers.
4. Aviation Safety Network. *Accident Description*. <aviation-safety.net/database/record.php?id=20060503-0>.

Fatigued

BY WAYNE ROSENKRANS



Objective data analyses to be available next year may offer the best chance yet for U.S. airlines, labor unions and regulators to come to terms with why individual cabin crewmembers sometimes work on flights suffering from what they consider severely degraded alertness. Then, mere opinions about the prevalence of fatigue serious enough to jeopardize flight attendant performance of safety-critical duties may carry less weight.

Airline and regulator interest in cabin safety-related studies by fatigue scientists and other specialists has been reflected in presentations at aviation safety conferences in anticipation of the results of the latest scientific inquiry by the U.S. Federal Aviation Administration (FAA). Cabin crew labor unions and other advocates of increased attention to the issue meanwhile hope that the evolving components of airline safety management systems (SMSs), such as aviation safety action programs (ASAPs) and fatigue risk management systems (FRMSs), will change the perceptions and the realities.

Some U.S. airlines remain unconvinced that any research involving subjective judgments of fatigue by flight attendants should serve as the basis of regulatory changes or airline policy changes. For example, the Air Transport Association of America's (ATA's) position is unchanged from when it argued against a national flight attendant duty/rest/fatigue survey, which nonetheless has proceeded as ordered by a congressional appropriations committee in September 2004.[1]

ATA says that survey had been inadequately described in the FAA's request for public comment on funding, and "the information obtained will not have practical utility, and the survey will not add to the FAA's efforts to define, enact and support policies and practices that effectively manage fatigue in aviation operations." Self-reported, subjective data cannot address questions of minimum crew rest regulations, reduced rest and potential regulatory revisions, the association said.

"The design and outcomes of any effort should include a clear path from study findings to an evaluation of whether further regulatory action is needed or warranted," ATA said. "[Three decades of research] activities have created an extensive scientific foundation to understand fatigue in aviation operations, including policies and practices that can reduce fatigue and enhance sleep, performance and alertness. … Regardless of the actual participants or measures in specific studies, the findings can be generalized and applied to the human operators in aviation, whether pilots, flight attendants, air traffic controllers or mechanics."

Status of FAA Research

Current research on flight attendant duty time, rest periods and fatigue by the FAA Civil Aerospace Medical Institute (CAMI) comprises six follow-up projects that closely track recommendations that CAMI issued in July 2007.[2] Based on limited information gathered in the time available, that report had listed sleep loss among the main factors in flight attendant fatigue.

This factor has been "shown in numerous studies to produce waking neurobehavioral deficits, which include vigilance degradations, increased lapses of attention, cognitive slowing, short-term memory failures, slowed physical and mental reaction time, rapid and involuntary sleep onsets, decreased cognitive performance, increased subjective sleepiness, and polysomnographic evidence [recordings during sleep of brain activity, eye movement and muscle tone] of increased sleep pressure," the report said. "Cumulative sleep loss results in sleep debt, with chronic sleep deprivation, night after night, leading to cumulative and progressive performance decrements, even in healthy adults."

Another main factor for flight attendants is circadian rhythm disruption, and a third is length of duty time. "Sleep loss and circadian rhythms interact dynamically to regulate changes in alertness and performance," the report said. "The effects of jet lag and shift work are often characterized by symptoms such as disrupted sleep, changes in mood state, loss of appetite, gastrointestinal disturbance and disorientation. … Fatigue during international flights

Photo Illustration: © Chris Sorensen Photogtaphy is due mainly to flight duration and time zone differences, while fatigue on domestic flights is related to total working hours, landing frequency (number of legs), workload and layover duration."

Research teams are scheduled to publish results from the current projects at the end of December, according to Thomas Nesthus, a research psychologist of the CAMI Human Factors Research Lab. One project is the national duty, rest and fatigue survey. The survey covers topics such as rate of occurrence of fatigue, working conditions in which fatigue occurred, consequences of fatigue, duty time and rest period schedules, and personal experience with airline practices.

and awake while on duty and off duty, among other objective data. The researchers planned to collect data to "explore the physiological and neuropsychological effects of fatigue, sleepiness, circadian factors, rest schedules, etc., on flight attendants … collect actigraphic data and light measurements to document flight attendants' sleep/wake schedules and exposure to zeitgeber cues [natural environmental signals that synchronize the human body's time-keeping system] from light," the 2007 report said. The participants also are completing sleep diaries to verify sleep/wake schedules.

Also under way is a content analysis of more than 2,000 de-identified event reports for "fuller understanding of

New FAA research probes flight attendants' anxiety over insufficient sleep and unsafe performance.

IN THE BACK

Of survey questionnaires distributed to a random sample of 20,835 flight attendants, a total of 10,549 (51 percent) were completed and returned by the March 31 deadline for subsequent de-identified analysis. By mid-year, all data had been scanned and entered into a database, and were being analyzed, Nesthus said.

A parallel project is a field study, for which nearly 6,000 flight attendants volunteered, with an integrated assessment of computer fatigue models. Following approval of the data collection protocol for research on human participants, a research team under contract to CAMI during May randomly selected and trained a sample of 210 individuals from those who volunteered, stratified by type of operation and seniority, he said.

"Over a dozen of these flight attendants [so far] have received and have been trained on the use of the personal digital assistant–cell phone devices that we are using in our field study to collect data over a 25- to 30-day period," Nesthus said. "This is a rather unique data-collection effort in regard to the limited attention that flight attendants have received in the research literature."

Data collection began in June, focusing on fatigue during line operations. Participants wear actigraphy sensors on their wrists to detect body motions, pedometers and other devices that fatigue scientists have developed to measure the times and durations of every period that flight attendants are asleep

© Dreamstime/Steven Pebble

fatigue-related incidents" involving flight attendants. This project included a related survey of all members of airline ASAP event review committees; the survey response was approximately 46 percent.

For the other projects, researchers have collected and content-analyzed 50 international regulations and agreements pertaining to policies or practices that affect flight attendant fatigue "to see how other countries address these issues" and "to provide additional data to supplement other ongoing research"; collected, reviewed and summarized global scientific findings on fatigue training and countermeasures in multiple transportation modes, such as rail, highway and aviation; and drafted a report on prospective benefits of training flight attendants on fatigue issues and implementing fatigue countermeasures. Such training would be expected to comprise "exposure to information on fatigue, its causes and consequences, its interaction with circadian disruption, and how and when to employ countermeasures (scheduled naps, physical activity, social interaction, caffeine, etc.)," CAMI said in the 2007 report.

"Regulations must be combined with sound and realistic operational practices, and supplemented, as needed, by personal strategies."

AFA-CWA Advocacy

The Association of Flight Attendants–Communication Workers of America (AFA-CWA), along with other unions, has advocated government research on flight attendant fatigue, drawing from findings of an internal survey of members in 2005, said Candace Kolander, coordinator of air safety, health and security, and a presenter during the February 2009 International Aircraft Cabin Safety Symposium (CSS).

Kolander

Wayne Rosenkrans

"Flight attendants typically still have to jump through hoops to say 'I'm fatigued' to their air carriers without disciplinary consequences," she said. "If carriers want to have a complete FRMS, they can't just look at fatigue in the front of the airplane, they need to look at fatigue in the back. We have made inroads. The response of volunteers to current CAMI research says that U.S. flight attendants are saying 'We do believe this is a problem,' and they want to ensure that the problem gets solved."

Echoing ATA's 2008 comments, AFA-CWA expects any changes to U.S. regulations to require a scientific basis, she said. Kolander said that prescriptive rules setting minimums — even for air carriers that demonstrate an equivalent level of safety from their FRMS — probably must continue, however, but with the misleading term "rest period" dropped in favor of "time off duty" or a similar term. This change would be recommended because "rest period" connotes time provided for sleep, but includes many routine activities such as riding on airport shuttle buses, checking into hotels, eating meals, bathing and dressing that reduce the sleep opportunity.

The airline practice of providing minimum regulatory rest periods between scheduled duty days has been perceived by AFA-CWA members as the main reason fatigue is an unresolved issue. Unless airline-labor agreements say otherwise, some flight attendants can be assigned to operate on patterns that can result in severe sleep debt, Kolander said.

The 2007 CAMI report said researchers at the time could not determine how widespread or problematic the practice is of scheduling flight attendants to operate according to the regulatory maximum for scheduled duty times — with the regulatory minimum rest periods and minimum subsequent rest — all based on science dating from the early 1990s. "To truly address the fatigue issue, regulations must be combined with sound and realistic operational practices, and supplemented, as needed, by personal strategies," the report said. Age, gender, general health, level of cabin crew experience and "the highly variable personal/domestic situation including commuting requirements" were the individual risk factors cited.

"We try to work with the carriers to do fatigue assessments of our members," Kolander said. "We also say to them, 'Let flight attendants call in fatigued without discipline, but also recognize and mitigate the problem by providing fatigue training in recurrent training classrooms.' Hopefully, the air carriers and the flight attendant community can come together and say, 'Here are some of the circumstances where flight attendants can report fatigued without threat of disciplinary action.'"

How flight attendants typically commute and use their off-duty time to obtain the optimal seven to nine hours of sleep also enter the picture. "I believe that U.S. flight attendants are becoming more aware that what they do off duty can have a bad effect on cabin safety — that awareness is a good thing," Kolander said.

Reports AFA-CWA received from fatigued flight attendants have said they had forgotten to arm their evacuation slides, Kolander told the symposium. "Others had forgotten that they had unaccompanied minors aboard the aircraft, and let them leave the aircraft on their own," she added. "We also hear from flight attendants about being pulled over by police because many of the effects of fatigue actually do mimic drunk driving. Yet just prior to being stopped, at the end of a long duty day, they had been on board an aircraft 'ready' to operate the emergency equipment. If their behavior was a hazard on the road, why was operating in a fatigued manner not a hazard on board the aircraft?

"Such anecdotes argue for the need to address flight attendant fatigue, and there has to be a nonpunitive approach. Meanwhile, we are trying to educate our own members that fatigue is important and that they do have to take responsibility to educate themselves, which means getting the proper rest."

Stop-Gap Energy Drinks

Acutely fatigued flight attendants sometimes have failed to communicate abnormal situations to the flight crew, said Lori Brown, an aviation science faculty specialist at the University of Michigan and the second presenter to focus on the issue at the 2009 CSS. In one example from her files, she described the fatigued flight attendant aboard a McDonnell Douglas MD-80 who, before departure from Chicago, told the captain via interphone that a "secure ID" had been found during preflight cabin checks. The captain conducted the takeoff with the understanding that a lost employee identification badge — not a suspicious electronic device with a countdown timer — had been found. Shortly afterward, the flight attendant inadvertently released the tail cone, which fell to the runway from the aircraft during the return for landing at the departure airport.

Wayne Rosenkrans

Brown

In recent conversations, some flight attendants have told Brown that the only fatigue countermeasure they routinely use is consuming extra coffee or, occasionally, carrying aboard and consuming cans of caffeinated beverages marketed as energy drinks. "To maintain alertness, the only real cure is to sleep," she told the symposium. "Caffeine can be effective, but the important thing is strategic use at the proper time in the proper way. That takes education."

For an enhanced version of this story, go to <www.flightsafety.org/asw/jun09/cabinfatigue.html>.

Notes

1. Berg, David A. ATA comments in response to FAA *Request for Comments, National Flight Attendant Duty/Rest/Fatigue Survey.* May 19, 2008.
2. Nesthus, Thomas E.; Schroeder, David J.; Connors, Mary M.; Rentmeister-Bryant, Heike K.; DeRoshia, Charles A. "Flight Attendant Fatigue." FAA Office of Aerospace Medicine. Final report no. DOT/FAA/AM-07/21, July 2007.

The only fatigue countermeasure they routinely use is consuming … cans of caffeinated beverages marketed as energy drinks.

Photo Illustration: © Chris Sorensen Photography

Fighting Fatigue: **A Team Effort**

BY DEBORAH A.P. HERSMAN

Seven-time Tour de France bicycle race champion Lance Armstrong possesses many physical attributes that make him an ideal biker, and he carefully trains to be the winner that he is. But Armstrong did not win any of those races by himself. Every time he crossed the finish line ahead of his competition, he did so with the help of a great team who carefully planned his success. Armstrong's team included doctors who developed meal plans and monitored his food consumption, physical trainers who developed a strict regimen of exercise, engineers who designed equipment and apparel that minimized wind drag, and other cyclists who surrounded Armstrong during the race to block wind and help him preserve his energy for the final sprint.

Top athletes will tell you that preparing themselves for competition is the key to success. This is a basic, uncomplicated concept, yet remarkably it often is ignored by other professions, including the aviation industry. I am not suggesting that flight crews should be doing Lance Armstrong-like training in their local gym before every flight. I am suggesting that our industry needs to provide a structure that enables and encourages flight crews to look after their physical well-being, especially before they board an aircraft full of passengers totally dependent on their performance in the cockpit. The most obvious component of good physical well-being is adequate rest. In my role on the National Transportation Safety Board (NTSB), I have seen firsthand the unfortunate results of operator fatigue in all modes of transportation.

How does fatigue affect a pilot? It reduces a pilot's ability to maintain situational awareness and clouds a pilot's ability to reliably detect, appreciate and respond to events in a timely manner. A fatigued pilot is more likely to take unacceptable risks. In the February 2007 runway overrun by Shuttle America Flight 6448 at Cleveland (CLE), the captain allowed the precision approach to continue to instrument landing system minimums even though he and the first officer were confused when the approach controller told them that the glideslope was unusable (*ASW*, 9/08, p. 22). While in deteriorating weather conditions, the captain did not take command of the landing, but instead gave this responsibility to the first officer whose piloting abilities he questioned. When the captain lost visibility after descending through the decision height, he did not reinforce his go-around callout or respond to the first officer's failure to execute the missed approach as instructed.

The captain had a severe sleep disorder and a demanding duty schedule. The accident occurred almost 10 hours into the captain's duty day, by which time he had been awake for about 31 of the 32 preceding hours. Although the captain acknowledged that he was tired, he might not have fully recognized the extent to which his fatigue impaired his performance during the flight.

Some experts believe that modern cockpits and other technology-rich transportation environments create periods when fatigue-based performance errors can occur without harmful results, leaving the false impression that there is no real cost to operating when fatigued. Consider the November 2004 accident involving the Gulfstream III that crashed while on final approach to Houston's Hobby Airport (HOU), where it was scheduled to pick up former President George H.W. Bush (*ASW*, 2/07, p. 28). The first officer made numerous small errors during the approach into HOU, including reporting incorrect automatic terminal information service information "Kilo" instead of "Quebec," reading back an incorrect runway assignment, failing to activate and identify the ILS frequency, failing to properly set the instruments to guide the crew on the glideslope, and failing to adequately scan the cockpit instruments. The NTSB learned in its investigation that the first officer did not have regular sleeping hours, and the captain had not obtained normal sleep during the previous nights. Multiple small errors over a short period of time often indicate fatigue.

Aviation accident data show that human performance–related airline accidents are substantially more likely to happen when pilots work long days, shifts at unusual hours or trips with a large number of takeoffs and landings. The NTSB's 1994 study of flight crew–related major aviation accidents found that captains who had been awake for more than about 12 hours made significantly more errors than those who had been awake fewer than 12 hours.

An airline that structures its flight crew scheduling strictly around the Federal Aviation Administration's (FAA's) hours-of-service regulations is not doing enough to ensure that its crews are not flying fatigued. For example, in the controlled flight into terrain of Corporate Airlines Flight 5966 in Kirksville, Missouri, in October 2004, the captain made a risky decision to continue the landing approach based on inadequate visual cues. He fixed his attention on visual information outside the cockpit to the exclusion of critical information on the airplane's instruments showing the descent rate and altitude. The accident flight crew had been on duty for 14.5 hours, and they had received early wake-up calls, around 4:30 a.m.

NTSB's interest in fatigue goes back more than a quarter century. In fact, this issue is on our "Most Wanted List of Safety Improvements," where we highlight the most critical transportation improvements needed. The NTSB continues to encourage the U.S. Department of Transportation to upgrade hours-of-service regulations in all transportation modes to assure that they incorporate the results of the latest research on fatigue and sleep issues. The NTSB also has recommended that the FAA end the practice of allowing flight crews to operate non-revenue training or repositioning flights after they reach their flight and duty time limits. Further, the NTSB is becoming more aware and concerned about the effects of sleep disorders in flight crews. Sleep disorders are treatable, but pilots need to be aware of the symptoms and the serious risks they pose if left untreated.

On its face, the fight against fatigue seems like a personal issue that must be addressed on an individual level, one pilot and one flight at a time. In fact, however, the fight against fatigue is a shared responsibility that must be addressed as a team effort, much like Lance Armstrong's team. The NTSB will continue to push for better fatigue awareness in the hope that the FAA will issue more science-based hours-of-service regulations, and that airlines will improve education, training and policies related to fatigue and structure crew schedules to minimize fatigue.

Pilots have to learn to recognize the signs of fatigue in themselves and in their fellow pilots, and take steps to prevent it. It will take all of these efforts to effectively and systematically address flight crew fatigue, but the team approach is not as complicated as it may sound. It could be as simple as thinking about each flight as a challenge to be won by a team supporting a professional in the best condition to provide optimum performance. It could be as simple as thinking about Lance Armstrong.

Deborah A.P. Hersman is a board member of the U.S. National Transportation Safety Board, and has been nominated to a term as chairman of the NTSB.

BY MARK LACAGNINA | FROM ORLANDO

Seminar focuses on strategies to further improve a good safety record.

DEDICATION *in tough times*

In these tough economic times, it is good to see that a lot of people are still very dedicated to safety," said William R. Voss, president and CEO of Flight Safety Foundation (FSF), welcoming the 300 aviation professionals who attended the 54th annual Corporate Aviation Safety Seminar (CASS) in Orlando, Florida, U.S., April 21–23.

Noting other issues challenging corporate aviation, Ed Bolen, president and CEO of the National Business Aviation Association (NBAA), co-presenter of the seminar, said, "We have been pilloried as being excessive, but one thing has never been questioned about business aviation: our safety record."

Reviewing recent accident investigations, Deborah Hersman, a U.S. National Transportation Safety Board member recently nominated to become NTSB chairman, pointed to a "long-standing safety issue" — fatigue. "This is an industry in which people are pushed and work tough schedules," she said. "I am happy to see that several of those in attendance here have voluntarily instituted SMS [safety management system] programs incorporating fatigue risk management."

Dr. Carol Ash, medical director of Sleep for Life at Somerset Medical Center, said, "Some say that sleep is only for wimps. Well, nothing can be further from the truth. Sleep, like oxygen, is a physiological need. We have the skills to perform satisfactorily in normal conditions when fatigued. It is when critical thinking is required that you will fail." Ash discussed fatigue countermeasures and noted that there are 84 types of sleep disorders. "Someone in this room probably has a sleep disorder and doesn't know it," she said.

A common sleep disorder, sleep apnea, has a direct effect on cognition, said Dr. Quay Snyder, president and CEO of Virtual Flight Surgeons, who discussed the many causes of cognitive impairment that can affect "the failing aviator" — a pilot with fading ability to fly proficiently and to complete training and check rides satisfactorily. Noting that "very few pilots self-report — that is, come in and say, 'I can't hack it anymore,'" Snyder discussed methods of identifying and helping failing aviators.

Earl Weener, a Foundation fellow, briefed the CASS participants on the FSF Runway Safety Initiative. He presented data showing that four of the 12 major accidents worldwide last year involving aircraft typically used in corporate aviation were runway excursions, with three occurring on takeoff.

Weener said that from 1995 through 2008, long touchdowns were involved in about one-third of the corporate aircraft excursion accidents. "Unstable approaches characterize most of the landing excursions," he said.

Freedom, Safety in Jeopardy

David Rimmer, executive vice president of ExelAire, and Kenneth P. Quinn, FSF general counsel and secretary, and a partner in the law firm Pillsbury, discussed the growing threat of aviation accident criminalization.

Rimmer was a passenger aboard the Embraer Legacy that collided with the Boeing 737 over the Amazon in September 2006 (*ASW*, 2/09, p. 11). He was subsequently detained and questioned by Brazilian police. Noting that several Brazilian congressional investigations also were launched after the accident, Rimmer said, "Politicians and prosecutors react to public outcries for 'justice.' Everyone feels that someone has to pay. … Criminalization threatens all of us. It threatens our freedom. And by interfering with the gathering of facts, criminalization threatens everyone's safety."

Rimmer and Quinn both said they were surprised by the absence of support by the U.S. government. "I was taken aback by how little the U.S. government did to intercede in the behalf of the pilots," said Quinn.

Quinn reviewed several criminal investigations launched in the wake of aviation accidents. Noting that everyone in a company can be involved in a criminal investigation, he provided advice on what to do if criminal charges are imposed. Hiring experienced counsel for everyone involved was near the top of the list. Quinn also cautioned that "in the first 72 hours, admissions can be made and stupid things can be done." The worst thing is destroying documents or erasing tapes. "You put in jeopardy the company and its affected employees when you destroy records," he said.

In a related presentation, D. Richard Meikle, vice president of safety for NetJets, discussed early perceptions about accidents. "People in your company and outside are going to form initial perceptions about what caused an accident very quickly," he said. "Initial perceptions are rarely accurate." Meikle recommended that company managers be prepared to gather and use factual information to manage perceptions. "If you don't tell people what might have happened, they will make it up."

In Tune With Technology

Briefings on the automatic dependent surveillance–broadcast (ADS-B) system were presented by Steve Brown, ADS-B co-chair of the U.S. Federal Aviation Administration (FAA) Aviation Regulatory Advisory Committee and senior vice president of operations for NBAA; David Bjellos, aviation manager for Florida Crystals Corp.; Rick Ridenour Sr., technical staff engineer/pilot for the FAA; and Pat Zelechoski, FAA ADS-B team leader.

Brown said that ADS-B is a "mature technology based on a better transponder … with a discrete code for each aircraft" that will improve aircraft-positioning capabilities and provide the means for cockpit display of traffic and weather information. "Initial implementation in the U.S. has been with UPS and operators in Alaska," he said. "Several other countries have demonstration programs under way."

Zelechoski noted that the system will enable air traffic control surveillance services to be provided in non-radar areas such as the Gulf of Mexico. The FAA currently is drafting ADS-B equipment requirements. "Where a transponder is required today, you will need ADS-B equipment," he said. "Cockpit displays will not be required, but most operators will want them."

"Although the system is being developed primarily for the airlines and commercial operators, corporate/business aviation will get some trickle-down benefits," said Bjellos. Examples: "ADS-B will provide separation all the way down to the runway, [and] weather information will be available in areas where it is not available today."

Expanding the discussion of equipment requirements, Ridenour said that electronic flight bags initially will be used for cockpit display of traffic information (CDTI) but that navigation and flight displays eventually will be used to display the information. "TCAS [traffic-alert and collision avoidance system] will continue, but CDTI will provide better accuracy and direction-of-travel information," he said.

Richard Fosnot, senior manager of aviation safety for Jeppesen, discussed the progress of performance-based navigation from the development of area navigation routes in the 1970s to today's required navigation performance (RNP) approach procedures, of which 144 have been approved worldwide. "RNP provides vertical navigation capability and lower minimums at airports without ILS [instrument landing system] approaches," he said.

The integration of unmanned aircraft systems (UASs) in the U.S. National Airspace System was discussed by Ardyth Williams, the FAA's UAS air traffic manager. "There are hundreds of them flying right now, and there will be more," she said. All of them must be operated according to Federal Aviation Regulations and are prohibited from being flown in Class B airspace and over populated areas.

Williams said that the FAA is working with other organizations on a TCAS-like sense-and-avoid system. "One problem is that, right now, none can meet performance requirements for an avoidance maneuver," she said. "Most cannot do half-standard-rate turns."

Safety Management

Several presentations explored the various elements of safety management systems. SMS audits, mostly of air taxi operators, have shown that acquiring the resources and expertise to establish an internal evaluation program and to develop an adequate SMS manual are the greatest challenges in implementing an effective SMS, said Steve Witowski, aviation safety program manager for the Aviation Research Group/U.S. "The SMS manual does not have to be the *Gutenberg Bible*," he said. "It must be simple and direct."

Witowski and Richard Bucknell, CEO of Southpac Aerospace, stressed the need for SMS training. "It does no good to have a 'paper' system that no one else knows about," Bucknell said. "People have to understand what you want them to do and where you want them to go. Without that, there's no buy-in." Bucknell focused on management's role in creating the company's safety culture. "Management needs to pull out the compass and say, 'This is the way we are going.'"

Management also must manage the company's "safety climate" to shape its safety culture, said Kenneth Neubauer, technical director of aerospace safety for Futron Corp. He described safety climate as the perceived state of safety at a particular time. "Unlike safety culture, which is very difficult to change, the safety climate changes regularly." Neubauer presented a four-step process for measuring and managing the company's safety climate. "The most difficult step involves taking actions and communicating them to staff," he said.

Gary Cooke, safety officer for CVS/Caremark, discussed the implementation of effective crew resource management (CRM) programs in small corporate aviation departments. "The key to having a good CRM program is strong leadership that supports the program and ensures that everyone understands what is expected of them," Cooke said. "CRM training should be conducted annually, but under the current stresses of the economic downturn that affect how well staff and crewmembers interact with one another, you might consider doing it twice or three times a year."

Unfulfilled

FAA data-analysis methods have prevented aviation safety action programs at U.S. airlines from achieving their full potential, a report says.

BY LINDA WERFELMAN

Photo Illustration: © Chris Sorensen Photography

The U.S. Federal Aviation Administration's faulty implementation of the aviation safety action program (ASAP) at U.S. air carriers has allowed the "inconsistent use and potential abuse" of the program, the U.S. Transportation Department's Office of the Inspector General (OIG) says.[1]

ASAP has been "highly beneficial" to the participating airlines, according to a May report by the OIG. However, the FAA has obtained only limited information from the program (*ASW*, 2/09, p. 40).

"When properly implemented, this program could provide valuable safety data to FAA," the report said. Nevertheless, "because FAA has not devised a method to gather sufficient data, little is understood about nationwide trends in the types of violations reported under ASAP, and ASAP reports do not help FAA determine whether systemic, nationwide causes of those violations are identified and addressed."

The report cited the FAA's failure to completely compile ASAP data as a "missed opportunity … to enhance the national margin of safety."

Seventy-three U.S. air carriers participate in ASAP, which encourages employees — most often pilots, although some programs have focused on maintenance personnel, flight attendants and dispatchers — to file confidential voluntary reports about situations that they believe are detrimental to safety.

Individual ASAPs typically are established as a partnership among the operator, the FAA and the employees' labor organization. An event review committee (ERC), comprising representatives of all parties included in the partnership, reviews reports filed by employees about any situation that they believe might present safety risks, to determine whether the reports should be accepted into ASAP and to recommend and help develop corrective actions.

ASAP and other voluntary safety-reporting programs are managed by the FAA Air Transportation Voluntary Safety Programs Branch, which reviews program implementation, collects ASAP data and analyzes the data to determine whether the program is achieving its safety goals.

The OIG issued eight recommendations to the FAA to help maximize the safety benefits of ASAP, including revising ASAP guidance to clarify which accidents or incidents should be excluded from the program and what constitutes an "intentional disregard for safety" — one of the conditions in which an event typically is not accepted under into ASAP under program rules.

FAA surveys from fiscal year 2005 through fiscal year 2007 found that ERC members "had difficulty interpreting [these] criteria for ASAP submissions," the report said. "Without proper clarification, determination of intentional disregard becomes strictly subjective, which can impede FAA's ability to take appropriate enforcement action."

The report challenged the current practice of accepting accidents, especially fatal accidents, into the program, reasoning that this "contradicts ASAP's fundamental purpose — to gather information on safety incidents *that might otherwise remain unknown* — because FAA already obtains safety information on accidents through internal and National Transportation Safety Board (NTSB) investigations."

In its response to the report, the FAA agreed to clarify what is meant by an "intentional disregard for safety" but said that an agreement to exclude some types of accidents from ASAP might have unintended consequences.

"FAA stated that because ASAP requires that a report be filed within 24 hours of the event and because airline employees trust the ASAP process, it is possible they will be more accurate and candid in an ASAP report than they might be in interviews with either NTSB or FAA representatives," the report said. "FAA also maintained that because the ERCs review and recommend corrective actions in a short time frame, this allows safety risks to be mitigated before either FAA or the NTSB completes [its] investigation."

The FAA said that it has begun talking with NTSB representatives to determine whether they agree that excluding some accidents from ASAP would be beneficial, the report said.

The report included seven other recommendations, which the FAA accepted. Among them is a recommendation that the FAA clarify that ASAP is not an "amnesty program" and that employees submitting ASAP reports remain subject to administrative action by the FAA and "corrective or administrative action" by their employer.

The report said that FAA statements about the role of ASAP have sometimes resulted in confusion and that this confusion led to the temporary suspension of ASAP at four airlines. All four programs were restored earlier this year.

"Partnership programs are intended to facilitate collaboration between FAA and air carriers to identify and correct safety issues," the report said. "We found, however, that FAA's guidance … is subject to misinterpretation regarding ASAP's purpose. As a result, some aviation employees have come to view it as an amnesty program and therefore believe that any corrective actions taken in response to an ASAP-reported incident, such as additional employee safety training, would be inappropriate. … This indicates a need for improved FAA guidance and additional education to clarify ASAP's intent."

Other recommendations included development of a central database of ASAP reports from all air carriers to be used to perform national trend analysis, standardization of ASAP guidance for quarterly reports, and a requirement that FAA inspectors examine repetitive reports of safety concerns "to ensure that corrective actions are completed in a satisfactory manner."

The OIG conducted the audit on which the report was based after a complaint from an FAA inspector who questioned whether the ASAP program should have accepted a Jan. 16, 2006, accident in which a contract mechanic was killed. The mechanic was attempting to locate the cause of an engine oil leak as two pilots conducted an engine run-up. The pilots asked that the accident be accepted in the air carrier's ASAP.

Note

1. U.S. Department of Transportation, Office of the Inspector General. *FAA Is Not Realizing the Full Benefits of the Aviation Safety Action Program,* Report No. AV-2009-057. May 14, 2009.

SPREADING CRM Instruction

BY PATRICK CHILES

Crew resource management might become a required curriculum for on-demand crewmembers.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On the heels of a recent proposal to revamp air carrier crewmember training (*ASW*, 4/09, p. 39), the U.S. Federal Aviation Administration (FAA) has moved to address another longstanding item on the U.S. National Transportation Safety Board (NTSB) "most wanted" list — to include crew resource management (CRM) in the required training programs for commuter and on-demand pilots and flight attendants.

Commuter operators with aircraft requiring two pilots or having more than 10 passenger seats have been required to provide CRM training since 1995. The notice of proposed rule making issued by the FAA in May would expand the requirement to all U.S. Federal Aviation Regulations Part 135 operators, including those with single-pilot aircraft.[1]

Reviewing Part 135 accidents during a 10-year period ending in March 2008, the FAA identified 244 in which ineffective CRM was a factor and 24 directly related to ineffective CRM. The following fatal accidents were cited as examples of "the critical need to require CRM training in both single- and dual-pilot Part 135 operations":

- The Raytheon King Air A100 crash at Eveleth, Minnesota, on Oct. 25, 2002. NTSB determined that neither pilot was monitoring the airspeed or course deviation indicators during the nonprecision approach.[2]
- The Piper Chieftain crash on Hawaii's Mauna Loa volcano on Sept. 25, 1999. NTSB faulted the pilot's navigation and disregard for standard operating procedures in continuing the visual air-tour flight into instrument meteorological conditions (IMC).[3]
- The Eurocopter AS 350BA crash on Mt. Waialeale, Hawaii, on June

25, 1998. The pilot was flying in two-minute trail behind two other company helicopters. None of the air-tour pilots had obtained a preflight weather briefing from an approved source, and the lead pilot failed to warn the other pilots about deteriorating weather conditions. The accident pilot became disoriented in the deteriorating conditions, misjudged his location and inadvertently entered IMC.[4]

"These three accidents were all the result of poor decision making, a loss of situational awareness, a lack of communication between multiple pilots … and other key operational personnel, and inadequate leadership," the FAA said.

Applying Team Concepts

As defined in Advisory Circular (AC) 120-51E, *Crew Resource Management*, CRM is the application of team concepts in the flight deck and cabin environment. As the concept evolved, it expanded to include effective decision making and problem solving by utilizing all resources, including dispatchers, flight attendants, maintenance technicians and air traffic controllers.

CRM has drawn attention to the subtle difference between command and leadership, encouraging pilots-in-command (PICs) to actively solicit input and other crewmembers to speak up when necessary. Problem solving is achieved through the effective use of individual skills, group communication and task management.

The FAA Aviation Rulemaking Committee tailored the proposed regulation to allow for the distinct differences between Part 135 operations and Part 121 air carrier operations. Similar to the recent Part 121 rule making, the proposed Part 135 rules would codify elements of longstanding FAA guidance. Operators would need to use AC 120-51E for guidance in developing their own CRM program comprising initial training, recurrent practice and feedback, and continuous reinforcement.

Initial CRM training programs typically vary instructional methods among lectures, videos, classroom discussion and operational practice in a simulator. Topics include PIC authority, team building, time and workload management, situational awareness, fatigue mitigation techniques, and aeronautical decision making specific to each company's operations.

The FAA believes that recurrent training is enhanced by reviewing performance-based, "real world" operational scenarios. These should be led by a properly trained facilitator who can provide constructive feedback. Through varied scenarios, this continual feedback process can hone leadership and decision-making skills among crewmembers. Along with formal recurrent training, CRM is expected to be continually reinforced in daily operations.

Line-oriented flight training, in which a full crew conducts a typical line flight in a simulator, is a prominent feature of many airline CRM programs. Several decision-making exercises can be presented in the course of a single flight. These often take the form of unexpected situations, encouraging the PIC to invite input and put the other crewmembers' abilities to their best use.

Challenge to Resourcefulness

With simulators currently less ingrained in Part 135 training, operators may need to plan on investing in simulator access or become very creative in the use of their existing equipment. For smaller companies, especially those operating single-pilot aircraft, it may be appropriate to place more emphasis on situational awareness, task organization and fatigue management. A combination of skill-building scenarios with a CRM facilitator and an approved flight training device could be put to good use in a small operation. For every challenge, there are often advantages: In the case of a small company with relatively few pilots, these team-building exercises could be more focused and effective compared with a large airline faced with thousands of potential crew pairings.

Anticipating that a large number of crewmembers will need this training, the FAA's proposal includes a two-year interval between adoption of a final rule and compliance by operators. Part 135 crewmembers would be required to complete initial CRM training during that time. There also is some expectation that many affected operators are "small businesses" entitled to seek additional time to comply.

If the Part 135 CRM training regulation is adopted, the good news for operators is that there is a wealth of easily accessible guidance on the market. Numerous textbooks, training aids and complete vendor-supplied programs are already available, thanks to the prevalence of CRM training by the air carriers.

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.

Notes

1. FAA. *Crew Resource Management Training for Crewmembers in Part 135 Operations*. Docket no. FAA-2009-0023. May 1, 2009. <edocket.access.gpo.gov/2009/pdf/E9-10085.pdf>.
2. NTSB report no. AAR-03/03. (*Accident Prevention*, 10/04).
3. NTSB report no. AAB-01-02. (*Accident Prevention*, 3/02).
4. NTSB report no. LAX98FA211.

CIS, Latin America Accident Rates Worsen

Runway excursions represented a fourth of all accidents worldwide.

BY RICK DARBY

Operators based in the Commonwealth of Independent States (CIS) and in the Latin America and the Caribbean region had the highest regional accident rates in 2008. They also had the greatest increases in accident rates compared with 2007, according to the International Air Transport Association (IATA) safety report for 2008.[1]

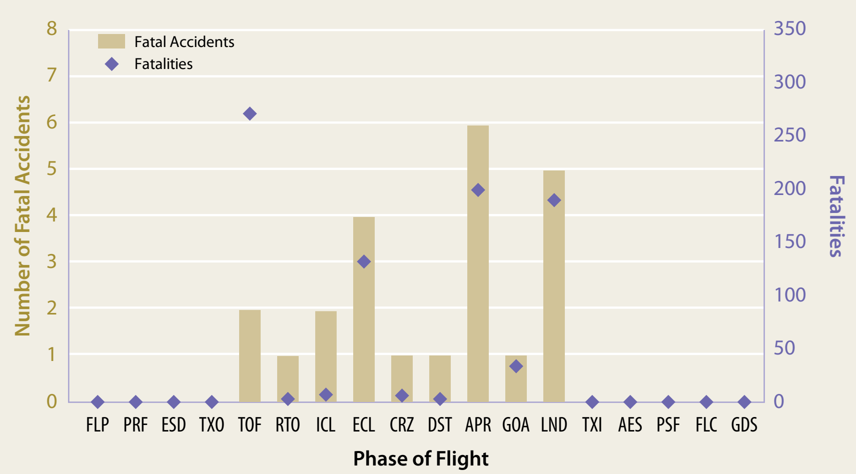
The IATA Africa region, comprising sub-Saharan states, had the highest proportion of fatal accidents relative to all commercial air transport accidents — 43 percent of accidents in the region involved fatalities. The Middle East and North Africa region almost matched Africa, at 42 percent.[2] The CIS accidents included 30 percent with fatalities; 26 percent of the accidents in Latin America and the Caribbean involved fatalities.[3]

Europe had the smallest proportion of fatal accidents in the developed world, 6 percent. For North America, the figure was 17 percent.

The distribution of accidents by phase of flight was fairly consistent across regions; typically, approach and landing predominated (Figure 1), and 43 percent of accidents occurred during landing. The breakdown according to accident category, however, varied considerably by region.[4]

For 2008 overall, runway excursions represented the largest accident category, at 25 percent of all accidents (Figure 2, p. 48). In Africa, runway excursions accounted for 58 percent of accidents. In Latin America and the

Worldwide Fatal Accidents and Fatalities, by Phase of Flight, 2008

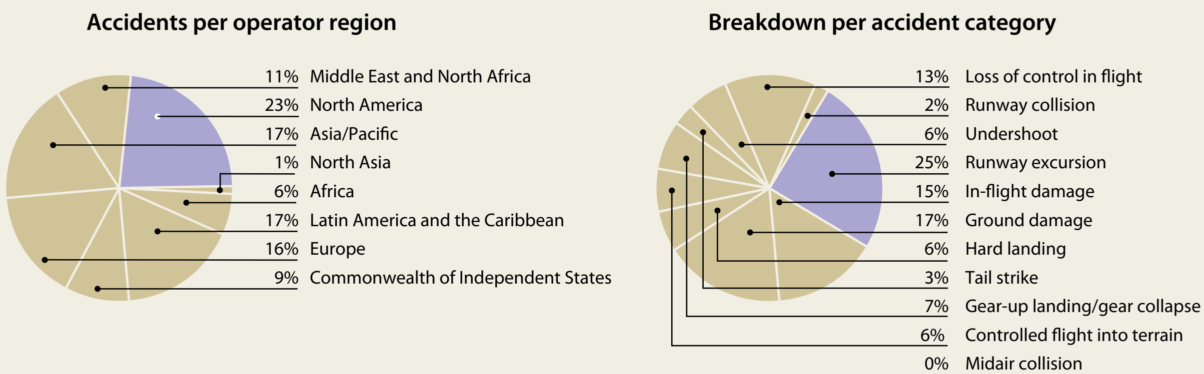


FLP = flight planning; PRF = preflight; ESD = engine start/depart; TXO = taxi out; TOF = takeoff; RTO = rejected takeoff; ICL = initial climb; ECL = en route climb; CRZ = cruise; DST = descent; APR = approach; GOA = go-around; LND = landing; TXI = taxi in; AES = arrival/engine shutdown; PSF = postflight; FLC = flight close; GDS = ground servicing

Source: International Air Transport Association

Figure 1

Worldwide Accidents, by Operator Region and Category, 2008

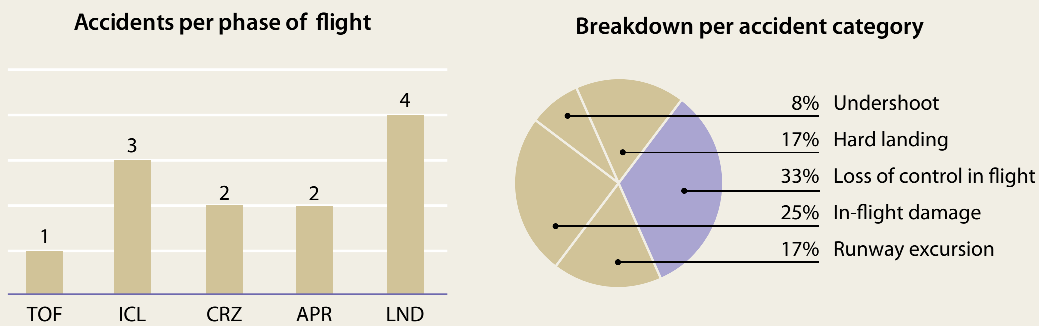


Note: Regions and accident categories are defined by the International Air Transport Association. The category with the highest percentage is shown in purple.

Source: International Air Transport Association

Figure 2

Middle East and North Africa Accidents, by Phase of Flight and Category, 2008



TOF = takeoff; ICL = initial climb; CRZ = cruise; APR = approach; LND = landing

Note: Regions and accident categories are defined by the International Air Transport Association. The category with the highest percentage is shown in purple.

Source: International Air Transport Association

Figure 3

Caribbean, the figure was 31 percent; in Europe, 29 percent. Among all regions, 14 percent of runway excursions resulted in fatalities.

There were 18 ground damage accidents, none fatal. Nevertheless, the report says, "Ground damage was the second most predominant type of accident, following runway excursions." The rate was highest in Asia/Pacific, at 2.66 per million sectors for all aircraft types. None was recorded in the category for North America.

In the Middle East and North Africa, 33 percent of accidents were categorized as loss of control in flight (Figure 3). In the CIS, the proportion was 30 percent (Figure 4). In contrast, 5 percent of accidents in Asia/Pacific involved loss of control in flight.

Controlled flight into terrain (CFIT) — for many years the leading cause of accidental death in Western-built large commercial jet operations and now second, behind loss of control — was absent in the year's accident toll in Europe, and the Middle East and North Africa. In Latin America and the Caribbean, 31 percent of accidents were CFIT; in the CIS, 10 percent.

For Western-built cargo jets, accidents occurred at a rate of 3.33 per 1,000 aircraft in 2008, compared with 2.69 per 1,000 Western-built passenger jets. For Western-built turboprops, the corresponding rates were 5.74 per 1,000 for cargo airplanes and 4.10 for passenger airplanes. In the 34 cargo aircraft accidents, in-flight damage — which included weather-related events, technical failures, bird strikes and smoke/fire/

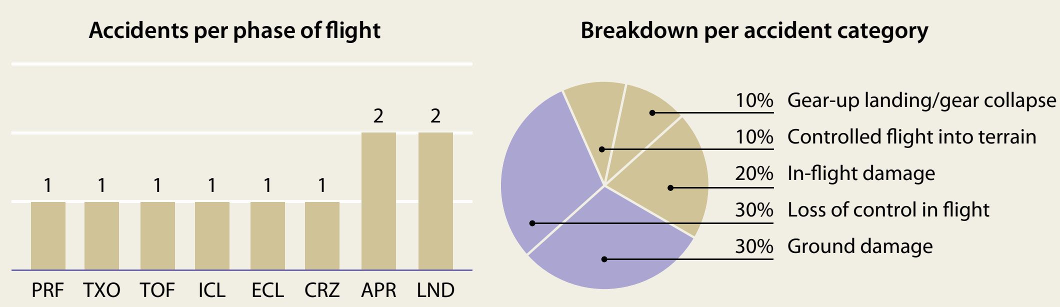
fumes events — was the most frequent category at 21 percent, closely followed by loss of control in flight and runway excursion (Figure 5).

Thirty accidents were described as cabin safety–related, involving factors such as passenger evacuation, decompression and on-board fire. The fatality rate for all cabin safety–related accidents was 20 percent. Runway excursions constituted 48 percent, and no other category accounted for more than 13 percent. Sorted by phase of flight, the landing phase had the highest rate, at 16 per million sectors for all aircraft types.

Rates of cabin safety–related accidents were highest in Latin America and the Caribbean, followed by the Middle East and North Africa (Figure 6, p. 50).

IATA's Accident Classification Task Force (ACTF) "with the benefit of hindsight, determines actions or measures that could have been taken to prevent an accident," the report says. "These proposed countermeasures

Commonwealth of Independent States Accidents, by Phase of Flight and Category, 2008



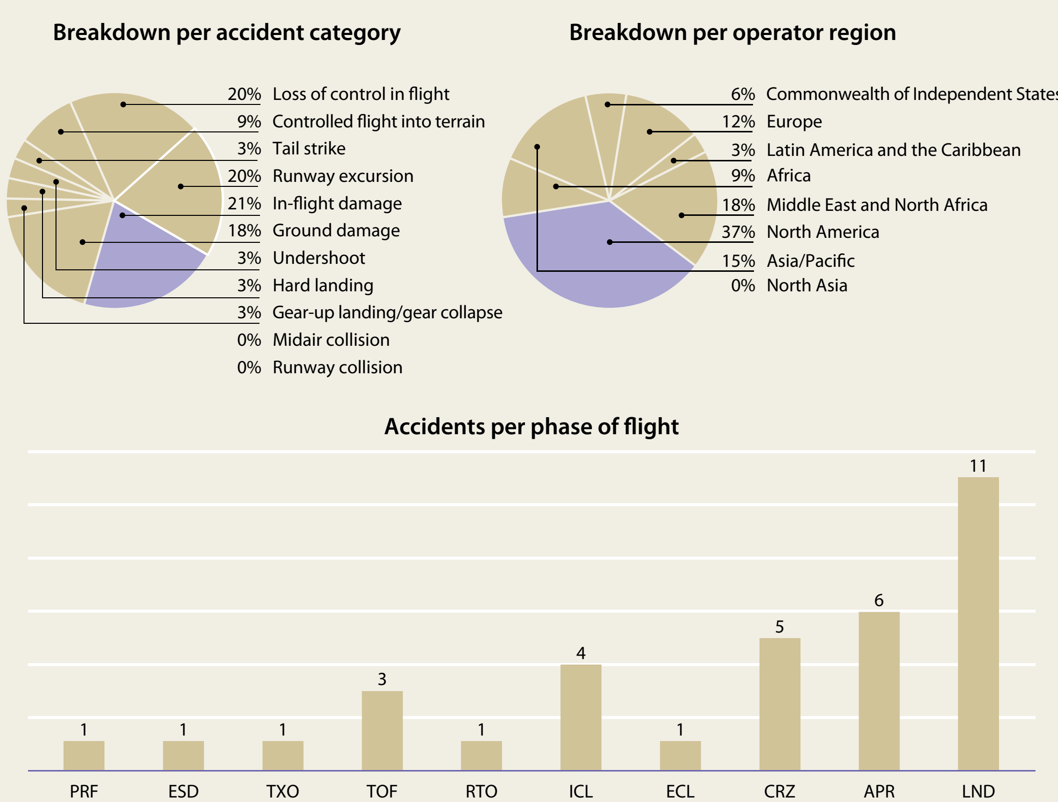
PRF = preflight; TXO = taxi out; TOF = takeoff; ICL = initial climb; ECL = en route climb; CRZ = cruise; APR = approach; LND = landing

Note: Regions and accident categories are defined by the International Air Transport Association. The categories with the highest percentage are shown in purple.

Source: International Air Transport Association

Figure 4

Worldwide Cargo Aircraft Accidents, 2008



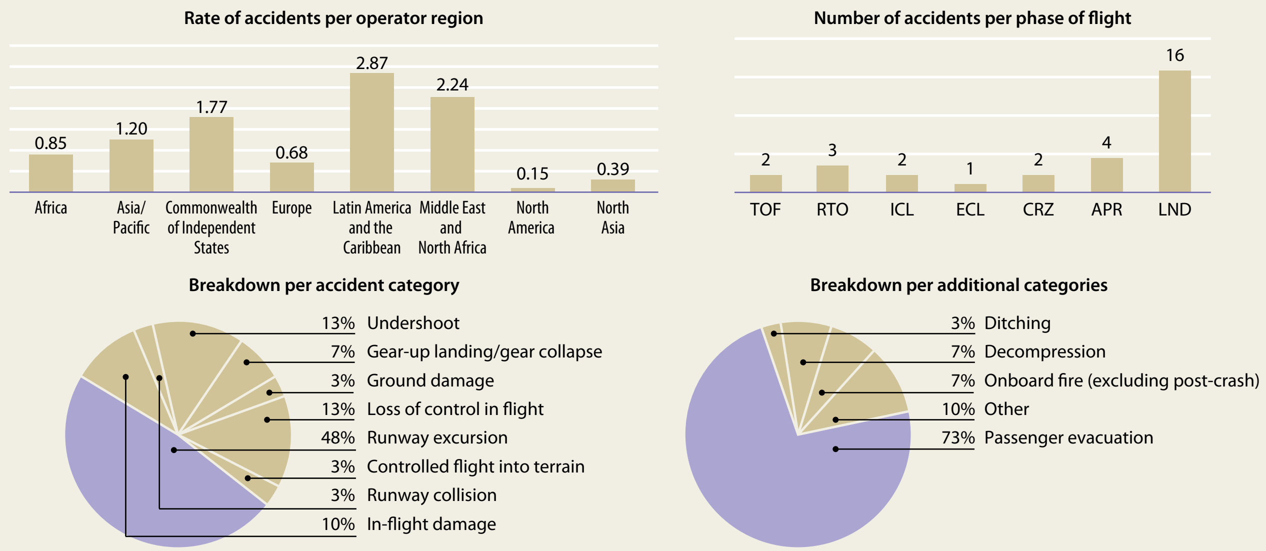
PRF = preflight; ESD = engine start/depart; TXO = taxi out; TOF = takeoff; RTO = rejected takeoff; ICL = initial climb; ECL = en route climb; CRZ = cruise; APR = approach; LND = landing

Note: Regions and accident categories are defined by the International Air Transport Association. The category and region with the highest percentages are shown in purple.

Source: International Air Transport Association

Figure 5

Worldwide Cabin Safety–Related Events, 2008



TOF = takeoff; RTO = rejected takeoff; ICL = initial climb; ECL = en route climb; CRZ = cruise; APR = approach; LND = landing

Note: Regions and accident categories are defined by the International Air Transport Association. The categories with the highest percentages are shown in purple. Rates are per million sectors flown for all aircraft types.

Source: International Air Transport Association

Figure 6

can include issues within an organization or a particular country, or involve performance of front line personnel, such as pilots or ground personnel."

Countermeasures can be enacted at two levels, the report says: the state responsible for oversight, and the flight crew. For each level, the ACTF calculated the percentage of accidents where countermeasures could have been helpful, categorized according to subject.

Related to the operator and the state, the task force found that the percentages of accidents where countermeasures could have been effective were 30 percent if they had been implemented by the operator's safety management, 27 percent for the state's regulatory oversight of the operator, 16 percent for the operator's training systems, 13 percent for the operator's standard operating procedures and compliance checking, and 12 percent for maintenance.

In connection with flight crews, the task force found that the percentages of accidents where countermeasures could have been effective were 28 percent for monitoring and cross-check, 21 percent for overall crew performance, 16 percent for contingency management, 9 percent for the communication environment, and 9 percent for leadership.

For each subject, the report discusses countermeasures that could have ameliorated or prevented a portion of the accidents.

Notes

1. IATA. *Safety Report 2008*. 45th edition. Reference no. 9049-09. Ordering information is at <www.iata.org/ps/publications/safety_report.htm>.
2. Middle East and North Africa represent a single IATA region. Geographical terms in this article refer to IATA regions.
3. The CIS region includes Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.
4. The report says, "At the request of member airlines, manufacturers and other organizations involved in the safety report, IATA developed an accident classification system based on the threat and error management (TEM) framework." Data in the report represent only accidents where there was enough information available for analysis, except in the percentages of fatal accidents.

Bird Watch

Declines in overall European bird populations do not reduce all bird strike hazards proportionately.

REPORTS

Startling Starlings

Bird Population Trends and their Impact on Aviation Safety 1999–2008

Maragakis, Ilias. European Aviation Safety Agency (EASA). January 9, 2009. 24 pp. Figures, photographs, references. Available via the Internet at <www.easa.europa.eu/essi/Documents.htm>.

In recent years the overall bird population has declined in Europe by more than 10 percent, the report says. Bad news for environmentalists but good news for the aviation industry? Not necessarily: "The bird strike hazard for aviation has not [been] reduced proportionally."

Not all birds are created equal in their threat to aircraft. The population of Canada geese, which recently achieved media stardom after a flock of them was implicated in the in-flight engine shutdowns of US Airways Flight 1549 and its subsequent water landing, has increased in northwestern Europe by more than 100 percent in recent years, the report says.

"The interest of aviation organizations has been attracted to this particular species because of their large size … and tendency to fly in flocks," the report says. Written before the Flight 1549 accident, it continues presciently, "It is feared that in case of a bird strike, their in-flight separation of 3 to 4 meters [9.8 to 13.1 ft] may potentially lead to strikes on multiple engines."

Just as unsettling, although the Canada goose is by nature a traveler, "in recent years a non-migratory trend has been observed, as the species has adapted to urban environments. Because of the species' habitat preference, near standing water and/or conurbation [extended urban] areas, it has become of primary concern for avifauna management in northwestern Europe."

Size and the tendency to fly in flocks are the most important determinants, aside from habitat, of the risk that bird species pose to aviation. Among flocking birds, gulls and starlings are considered to represent a high risk. Gulls "feed on soil invertebrates on aerodromes, farmland, etc. and on landfill sites," the report says. "It has been observed that flightlines of gulls are most likely to occur between landfill sites and roost sites, and it is these movements that frequently cause grave concern." Many newer airports are built on landfill because no land in dense urban areas was suitable or available for them.

Starlings are very much birds of a feather; they fly in groups as large as 100,000, and their mass is 27 percent larger than that of gulls, the report says. The starling population has declined by almost 50 percent in Europe in the past 35 years, but because of their size and behavior, "changes in their population might not reflect a proportional decrease [in] the risk to aviation," the report says.

Nor have all species declined in population. "Climatological changes have allowed new species to forage and breed in geographic areas which were not particularly suitable to them several decades ago," the report says. "The ban of organochloride pesticides has also enabled some bird species populations to increase from their low levels in the 1970s. … Some of the wildlife protection programs have introduced a population increase of some large bird species which were almost extinct a few decades ago. For example, 24 of the 36 largest bird species (weight greater than 2 kg [4.4 lb]) in North America have shown significant population increases in the past 30 years, and only three species have shown declines."

The report also examines whether certification criteria for airframes and engines have kept pace with the evolution of the bird strike threat. "To this end, large-bird certification requirements [for engines] have recently been extended to include provision for large flocking-bird tests, in order to take into account recent concerns about changes in the European avifauna, as it has also been highlighted by the U.K. [Civil Aviation Authority]," the report says. "All the certification requirements [for a single large flocking bird and multiple birds of varying size] have been progressively updated after a number of bird strike accidents changed the perception of the hazard."

For airframes larger than EASA's commuter light classification, the original certification criterion was that the aircraft should be able to safely continue flying after striking a 1.8 kg [4 lb] bird at design cruise speed. "For the aircraft empennage in particular, this requirement has been increased to 3.6 kg [7.9 lb] following an accident [involving] a Vickers Viscount in the 1960s," the report says.

At altitudes above sea level in the standard atmosphere, the true airspeed of an aircraft is faster than the indicated airspeed, although the type of airspeed displayed typically is selectable on electronic flight instruments. "Therefore, a bird strike at a specific indicated airspeed will have greater kinetic energy as the atmospheric altitude increases," the report says. "This change in airspeed is not commented on in the regulations … . In addition, in recent years questions have been raised regarding the degree to which certification tests are representative of real bird-impact conditions, when these tests are conducted on carbon fiber polymer material."

"A bird strike at a specific indicated airspeed will have greater kinetic energy as the atmospheric altitude increases."

The author of the report could find no standardized training for flight crews about bird hazards or any regulation requiring such training.

"The seasonal pattern of bird strikes is confirmed from all sources, indicating that the highest number of bird strikes occurs in the months between April and October," the report says. That is also a period of increased traffic, but even when traffic is factored in, the seasonal pattern holds true.

"The seasonal pattern may also affect the altitudes with the highest risk of a bird strike," the report says. "For example, July through November are considered the worst months for damaging strikes in the airport environment below 500 ft agl [above ground level]. During late summer, bird populations are at their highest levels and include many young birds that are not skilled flyers. Above 500 ft, September–November and March are considered the most dangerous months because these are the peak times of migration."

"Altitude information was not available in most of the occurrence reports used in this review," the report says. "Using various other sources of raw and derived data, it can be concluded that most of the occurrences, 95 percent, occur below 2,500 ft AMSL [above mean sea level] and around 70 percent occur below 200 ft. … This highlights the fact that the risk of bird strikes can be mitigated by measures taken primarily at an aerodrome level, such as avifauna assessment and management."

Analyzing 71 bird strike accidents during the decade 1999–2008, the researchers found that four of the six fatal accidents occurred during the takeoff phase, and 84 percent of all bird strike accidents in the database occurred during takeoff, approach or landing.

"Some past studies have indicated that aircraft with low noise-level engines have a greater risk of a bird strike because the low noise decreases the warning and reaction time of birds," the report says. "No such relationship could be confirmed within the data set used. On the other hand, engine configuration is understood to play a significant role [in] the probability of a bird strike damaging the engines, as it has been found that wing-mounted engines have five times more probability of being hit by a bird in a bird strike incident than fuselage-mounted engines."

The area damaged the second-most frequently — in 23, or 31 percent, of the accidents — was the wing structure. "In four out of the 23 cases, the bird strike led to a puncture of the fuel tank and consequently to fuel leakage," the report says. "For these cases it was a single large bird or a flock of large birds that hit the aircraft. … There are no fuel tank–specific requirements on this subject, and this may need to be reviewed."

For the bird strike hazard to be assessed and mitigated, "it is of the utmost importance that reporting of such occurrences improves significantly," the report says.

U.S. Pilots: Fewer and Older

An Analysis of the U.S. Pilot Population From 1983–2005: Evaluating the Effects of Regulatory Change

Rogers, Paul B.; Véronneau, Stephen J.H.; Peterman, Connie L.; Whinnery, James E.; Forster, Estrella M. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-09/9. Final report. May 2009. 23 pp. Figures, tables, references. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/2009> or from the National Technical Information Service.*

The changing aviation industry and regulatory changes — particularly raising the age limit for commercial pilots from 60 to 65 years in 2006 — have raised interest in the question of how the U.S. civil pilot population as a whole has changed over the years.

This study, using data for 1983 through 2005, was based on the records of U.S. pilots who obtained medical certificates in all three classes during that period. "The level of medical certificate, the year it was earned and the age of the airman at the time of the medical exam determines the length of time the airman is qualified to remain in the population," the report says. Those data gave the researchers a snapshot of the numbers of U.S. pilots in any year, as well as demographic information — gender, medical class, age and flight experience in years.

"Thus, the statistical results are population parameters, rather than estimates, and are not subject to sampling error," the report says.

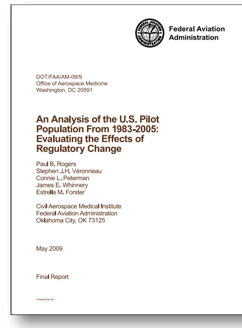
The overall U.S. pilot population is "indisputably in decline," the report says. The number of pilots declined by 200,000 during the 23-year period, the study found. "This is an indication that the industry has gone through deep-seated changes in the past 40 years," the report says. But the decline in numbers varied among pilots with different classes of medical certification. Those with first-class certificates, needed for an airline transport pilot rating, increased.

"There were more third-class medical certificate holders than any other, but those numbers were in decline," the report says. "Second-class medical certificate holders numbered less than half that of third-class medical certificate holders, and they too were in decline. First-class medical certificate holders initially numbered less than either second- or third-class medical certificate holders but were generally increasing and were close to overtaking second-class medical certificate holders in recent years, in terms of overall numbers."

In analyzing the findings, the report says, "More first officers may be seeking first-class medical certificates to be able to upgrade to captain status or may be fulfilling requirements from their companies that they hold higher medical certificates than required by the federal regulations. Finally, commercial operations requiring a first-class medical certificate such as airline operations may be expanding, which is why we have observed an increase in this category. Our findings suggest that one or more general aviation components are declining, while air carrier and other commercial operations requiring a first-class medical certificate are growing."

The average age of the overall pilot group increased during the study period for both men and women. For men, the lowest median age was 37 in 1983 and the highest was 45 in 2005. For women, the lowest median age was 32 in 1983, and highest — at 38 — in 1998, 1999 and 2005.

"Although women, as a group, were gradually aging, they were still younger than male aviators," the report says. "Breaking our analysis down by gender revealed that, since female pilots were younger than their male counterparts, their accumulated flight time was lower."


Federal Aviation Administration

DOT/FAA/AM-09/9
Office of Aerospace Medicine
Washington, DC 20591

An Analysis of the U.S. Pilot Population From 1983-2005: Evaluating the Effects of Regulatory Change

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

May 2009

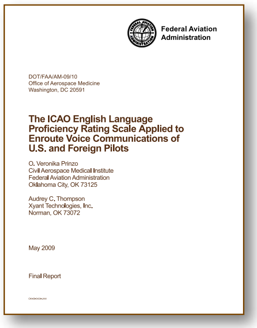
Final Report

Language Level Busts

The ICAO English Language Proficiency Rating Scale Applied to Enroute Voice Communications of U.S. and Foreign Pilots

Prinzo, O. Veronika; Thompson, Audrey C. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-09/10. Final Report. May 2009. 17 pp. Figures, tables, references. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/2009> or from the National Technical Information Service.*

"Non-native English-speaking pilots are at a disadvantage flying into countries where their primary or native language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The ICAO English Language Proficiency Rating Scale Applied to Enroute Voice Communications of U.S. and Foreign Pilots

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May 2009

Final Report

is not spoken," the report says. "Not only must they be able to understand spoken English, the language of aviation, but also speak it when communicating with air traffic controllers."

Hoping to alleviate the longstanding and vexing problem of varying degrees of fluency in English among pilots and controllers, in March 2008 the International Civil Aviation Organization (ICAO) implemented language proficiency requirements: "Aeroplane and helicopter pilots and those flight navigators who are required to use the radio aboard an aircraft shall demonstrate the ability to speak and understand the language used for radiotelephony communications." ICAO requirements also say that "air traffic controllers and aeronautical station operators shall demonstrate the ability to speak and understand the language used for radiotelephony communications."

To retain their licenses, pilots, navigators, controllers and station operators must demonstrate at least Level 4 — "Operational" — ability in speaking and understanding. Failure to reach Level 6 — "Expert" — language proficiency will require retesting at least once every three years for those at Level 4 or every six years for those at Level 5, "Extended."

Two previous reports examined pilot-controller communication in the en route environment (*ASW*, 7/07, p. 54, and 1/09, p. 55). In this third and final report of the series, the researchers "apply the six operational levels of language proficiency scales to communications problems using the same database as the two previous reports. By restricting the analyses to only identified communication problems, we should gain a better understanding between the operational levels of the language proficiency scales and communication problems."

The previously identified problems were re-examined and rated according to ICAO's six dimensions of language proficiency — pronunciation, structure, vocabulary, fluency, comprehension and interaction. Each dimension is rated according to a scale from Level 1, or "Pre-Elementary," to Level 6.

Transmissions — 1,371 in all, made by 58 controllers — were examined. Among those controllers, all but one received a rating of "Extended," or Level 5, because ICAO language proficiency ratings are determined from the lowest rating awarded on any of the six dimensions. "An examination of the rater's notes indicated no problems with 80.5 percent of the controller's messages, and fillers such as 'ummm' and 'uh' appeared in 15 percent of their utterances," the report says.

Among the "U.S.-English" aircraft pilots, those who flew for U.S.-based airlines, "100 percent of the pilots' utterances were awarded [a rating of] Expert in structure, comprehension and interaction, while 99.4 percent achieved a rating of Expert for pronunciation and fluency. All of their utterances were rated as Extended in vocabulary," the report says. All the "foreign-English" pilots, those who flew for non-U.S. airlines but whose native language was English, were rated Expert on five dimensions and Extended on vocabulary.

Transmissions from "foreign-other" aircraft pilots, who flew for non-U.S. airlines and whose native language was not English, were more varied. "Their utterances received ratings that varied from Expert to Operational on all but structure — of which slightly more than 93 percent received a rating of Expert," the report says. "Approximately 65 percent of the transmissions were rated Expert for comprehension and 74 percent for interaction; 47 percent received a rating of Expert on pronunciation and fluency. Between 30 percent and 37 percent of their utterances were awarded Extended on pronunciation, fluency and comprehension; and 23 percent on interaction. Nearly 23 percent of the pilots' pronunciation was awarded a rating of Operational. About 16 percent of their transmissions also received a grade of Operational on fluency, and only 3 percent were rated as Operational on comprehension and interaction."

Among all the 1,414 pilot communications, English language proficiency was a factor in 18.2 percent of problem communications, the report says.

The researchers found a subjective element in the ICAO descriptors, which guide graders in assigning numerical scores for each dimension. "It would help graders to have quantifiable metrics when rating pilots, controllers and other aviation personnel on their language proficiency,” the report says. “The ICAO descriptors may be a necessary first step in meeting the goals of the ICAO but may unavoidably introduce inconsistencies between graders. In particular, will graders use the same metric on which to determine what ‘almost never,’ ‘rarely’ or ‘consistently’ means?”

The report’s recommendations include the following:

- “Increase awareness of the importance of good microphone techniques and the issues arising from the technical aspects of ATC delivery to reduce the technical challenges;
- “Increase awareness of good/bad communication techniques and message receiving and delivery issues to improve message delivery among pilots and controllers;
- “Provide native and non-native English-speaking pilots and controllers with radio broadcast training programs to reduce the number of communication problems attributable to speech delivery;
- “Increase awareness of what native speakers do (e.g., elision, use of non-standard phraseology, poor enunciation with every-day language) to improve ATC transmissions among pilots and controllers; [and,]
- “Conduct further research to quantify the ICAO descriptors in practical terms.”

— Rick Darby

WEB SITES

Magnificent Seven Versus Dirty Dozen

Maintenance and Ramp Safety Society, <www.marss.org/index.htm>

Maintenance and Ramp Safety Society (MARSS), a Canadian nonprofit organization “dedicated to reducing aviation human error,” offers safety products and services on its Web site to members and nonmembers.

Colorful, animated human error posters are motivational and educational, identifying the “dirty dozen” factors that affect safety, quality of workmanship and quality of personal and workplace life. “The Dirty Dozen” posters focus on lack of communication; complacency; lack of knowledge; distraction; lack of teamwork; fatigue; lack of resources; pressure; lack of assertiveness; stress; lack of awareness; and norms. Negative illustrations are followed by solutions called “safety nets.”

For example, a poster on “complacency” illustrates a technician deliberately failing to inspect an area on an aircraft because “I’ve looked back there one thousand times and never found anything wrong.” The poster then offers two “safety net” messages to counteract complacency: “Train yourself to expect to find a fault” and “Never sign for anything you didn’t do.”

Continuing with the movie title theme, another series of posters is called “The Magnificent Seven,” with slogans such as “Safety is not a game because the price of losing is too high.”

MARSS also offers training videos. They include “Helicopter Risk Management,” which was produced by Transport Canada; “Anatomy of an Accident”; “To Kill a Whopping Bird”; “Human Performance in Maintenance”; “Human Factors in Aircraft Maintenance”; and “The Death of an Airline,” about the chain of events that resulted in low tire pressure on an airliner that led to a crash with 161 fatalities.

“The aim of all these videos is to enable viewers to spot the links as they form, and determine what safety nets can be used to stop that chain [from] forming,” the Web site says.

Clicking on the title of a video opens a window that provides a brief preview. Order forms and pricing appear on the Web site.

— Patricia Setze

Source

* National Technical Information Service <www.ntis.org>

Wayward Approach

The pilots mistook the lighting on a nearby hotel for the runway approach lights.

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

'Major Degradation of Situational Awareness'

McDonnell Douglas MD-83. No damage. No injuries.

The crew, which consisted of two pilots and four flight attendants, had conducted a positioning flight from Dublin, Ireland, to Belfast, Northern Ireland, and a charter flight to Lisbon, Portugal, and were returning to Dublin with 112 passengers the night of Aug. 16, 2007. The copilot, 62, who had 11,000 flight hours, including 4,500 hours in type, was the pilot flying. The commander, 42, had 5,077 flight hours, including 2,626 hours in type.

"The flight progressed without incident until commencing its approach to Dublin Airport," said the report by the Irish Air Accident Investigation Unit (AAIU). Night visual meteorological conditions (VMC) prevailed, with surface winds from 260 degrees at 12 kt, visibility greater than 10 km (6 mi) and a few clouds at 2,000 ft.

The flight crew had prepared for an ILS (instrument landing system) approach to Runway 28, but that runway was closed for scheduled maintenance as the MD-83 neared Dublin Airport. The approach controller cleared the crew to conduct the VOR DME (VHF omnidirectional radio, distance measuring equipment) approach to Runway 34. The copilot briefed the commander on the nonprecision approach. The minimum descent altitude was 720 ft, or 518 ft above the runway touchdown zone elevation. The VOR was located beyond the departure end of the runway, and the missed approach point was over the approach threshold, 5.2 nm DME (9.6 km) from the VOR.

The approach controller provided radar vectors to help the crew establish the aircraft on the final approach course, 342 degrees, at 2,900 ft and 8 nm (15 km) from the runway. When the crew established radio communication with the tower controller, the commander reported that they were "established on radial 162 inbound." The tower controller cleared the crew to land on Runway 34.

The MD-83 was about 5 nm (9 km) from the runway and at 1,900 ft when it began to deviate left of the final approach course. "This deviation was due to the flight crew misidentifying the lights of a hotel at Santry Cross as those of the runway approach lighting system on Runway 34," the report said, noting that the lighting on the 16-story building, which is about 3.0 km (1.6 nm) southwest of the runway, "closely resembled" the approach lights. "It was also evident that, under night conditions, the approach lighting can be difficult to identify due to extraneous lighting from the city environs."

Because of the left crosswind, the aircraft initially was on a heading of about 336 degrees to track the final approach course. "Thus, the aircraft was pointing to the left of the runway and toward the lighted building," the report said.

At about 2334 local time, the commander became puzzled by the absence of runway edge lights ahead. He radioed, "Tower, confirm that you have … all lights on three four on." The tower controller, who had been distracted by communications with airport maintenance personnel, noticed that the aircraft was significantly off track and told the crew to "turn right now, turn right … You're not landing on the runway. … Climb to two thousand feet." A minimum safe altitude warning then sounded in the control tower.

The aircraft was at 580 ft — 373 ft above ground level (AGL) — when the copilot initiated the go-around. "At the point where the go-around commenced, the aircraft was approximately 520 m (1,706 ft) from the building and 61 m (200 ft) above it," the report said. "After considering the wind, the flight crew accepted vectors and completed an ILS [approach to] Runway 16, landing without further incident at 2354."

Among the findings of the investigation were that the flight crew did not comply with the published approach procedure or with company standard operating procedures, and that they exercised poor crew resource management. Noting that the incident involved "a major degradation of situational awareness," the AAIU said that the probable cause was "the decision of the flight crew to continue an approach using visual cues alone, having misidentified the lights of a building with the approach lights of the landing runway."

Among the contributing factors was that "the fixed red obstacle lighting on the roof of the building, together with the white internal lighting, resembled the approach lights of the landing runway when viewed from the approach path," the report said.

Electrical Failure Ignites Insulation Blankets

Boeing 777-200. Substantial damage. No injuries.

There were 20 crewmembers and 185 passengers aboard the 777 when it was pushed back from a stand at London Heathrow Airport the night of Feb. 26, 2007. After the towbar was disconnected, the flight crew started both engines in quick succession, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The engine starts appeared to be normal, but "at about the time when the engine integrated drive generators (IDGs) would normally come on line, the flight crew saw the instrument displays flicker and heard a low-pitched, intermittent growling noise coming from the aft right side of the flight deck," the report said.

The engine indicating and crew alerting system showed that the right main alternating current electrical bus had failed. The crew also received indications that electrical power had been isolated from the right IDG and that the right bus tie breaker had tripped. "The flight data recorder (FDR) revealed that 40 seconds after both engines had stabilized at ground idle, the smoke detector inside the main equipment center (MEC) detected smoke," the report said. "The MEC is located beneath the flight deck and contains the majority of the aircraft's electric and avionics equipment."

Investigators determined that an internal failure had occurred in the right generator circuit breaker or right bus tie breaker contactor. "The failure resulted in severe internal arcing and short circuits inside the two main power contactors of the right main bus," the report said. The arcing and short circuits generated temperatures exceeding 1,000º C (1,832º F) and likely caused the growling noise that the crew heard.

"The heat generated during the failure resulted in the contactor casings becoming compromised, causing molten metal droplets to fall down onto the [fire-resistant] insulation blankets below," the report said. "The insulation blankets ignited, and a fire spread underneath a floor panel to the opposite electrical panel, causing heat and fire damage to structure, cooling ducts and wiring."

The commander became puzzled by the absence of runway edge lights ahead.

Recorded flight data indicated that 680 kg (1,499 lb) of fuel had leaked from the wing tanks during the flight.

The crew detected a faint odor of electrical components burning, and the commander told the first officer to shut down the right engine. They were conducting checklists related to the anomalies when they were alerted by ground crewmembers that smoke was emerging from the MEC vent. The crew taxied the 777 to a nearby stand. "Once on stand, the flight crew shut down the left engine and the APU [auxiliary power unit], at which time light smoke appeared in the flight deck," the report said. "The batteries were switched off, and the passengers and crew disembarked via steps placed at the aircraft."

Airfield fire service personnel found the MEC filled with smoke, but the fire had self-extinguished. "They manually opened the forward cargo compartment and removed two cargo pallets to check for any additional signs of fire, but none were found," the report said. "The smoke slowly cleared in the MEC to reveal obvious signs of fire damage."

The AAIB said that the cause of the right main bus power contactor failures could not be determined conclusively but most likely was a debris-induced short circuit. "A number of modifications to the contactor design have been carried out that should make the contactor more resistant to failure," the report said. Among recommendations generated by the investigation was that the trays beneath the contactor casings be redesigned to prevent hot debris from dripping onto the insulation blankets (*ASW*, 5/09, p. 9).

Missing Bulletin Factors in Fuel Leak

Embraer 190-100. No damage. No injuries.

The aircraft was climbing through 25,000 ft, en route from Brisbane, Queensland, Australia, to Honiara, Solomon Islands, with 40 passengers and five crewmembers the morning of Sept. 2, 2008, when the cabin crew told the flight crew that they saw vapor streaming from both wings.

"The pilot-in-command walked back to check and confirmed fuel streaming at a high rate from both wings," said the report by the Australian Transport Safety Bureau (ATSB). The flight crew reported the problem to air traffic control (ATC) and requested and received clearance to return to Brisbane.

"Cabin crew reported that the fuel venting/leakage momentarily stopped about eight minutes later but then resumed when the aircraft flaps were extended at about 4,000 ft on descent into Brisbane," the report said, noting that the leakage noticed during descent likely was residual fuel released when the flaps were extended. The 190 was landed without further incident, and airport rescue and fire fighting personnel found that the leaks had stopped.

The aircraft had departed from Brisbane with 12,800 kg (28,219 lb) of fuel. Recorded flight data indicated that 680 kg (1,499 lb) of fuel had leaked from the wing tanks during the flight.

Embraer had published an operation bulletin in February 2007 that advised 190/195 operators of the possibility that fuel can leak from the wings during climb at indicated airspeeds above 300 kt. The bulletin said that the airflow over the underwing ducts, which maintains positive pressure within the surge tanks, may become altered, causing surge tank pressure to decrease and force the float vent valves to close. This can result in fuel above the main vent lines in the wing tanks being "boosted" into the surge tanks and vented through the ducts. The bulletin says that if fuel quantity exceeds 5,000 kg (11,023 lb) on takeoff, airspeed during the climb should be maintained below 290 kt.

The incident aircraft's airspeed was nearly 300 kt when the cabin crew noticed the fuel leak. The aircraft operator and its flight crews were not aware of the information in the Embraer bulletin. "The operator advised the ATSB that they did not have access to the bulletin at the time of the occurrence," the report said.

Out-of-Rig Main Cabin Door Jams

Bombardier CRJ200. No damage. No injuries.

After a flight from Los Angeles to Phoenix with 50 passengers and three crewmembers the afternoon of June 13, 2007, the flight attendant was unable to open the main cabin door. She summoned the first officer, but he also was unable to open the door. The first officer summoned a maintenance technician, who entered the CRJ through the galley service door, said the report by the U.S. National Transportation Safety Board (NTSB).

"The mechanic manipulated the cabin door opening lever from inside the passenger cabin, and he successfully opened the door," the report said. "Initially, the operator's maintenance personnel examined the door, lubricated it and indicated the door was functionally okay."

An investigation of the incident was initiated by an NTSB investigator who was among the passengers. "Maintenance personnel subsequently examined the door and found that it was out of adjustment (rig) and that some internal components were inoperative," the report said. Repairs included replacement of the door's pushrod and spring assembly, adjustment of the release lever rod end, replacement of the inoperative door-assist motor, and repositioning of the lock/unlock indicators.

Examination of the operator's maintenance data revealed 13 discrepancy reports on opening and closing the door between January 2006 and June 2007. More than 800 similar service difficulty reports (SDRs) dating back to 1994 were found in the Canadian and the U.S. SDR databases.

In the incident report, NTSB faulted "the operator's inadequate maintenance program and the airframe manufacturer's inadequate response to the issue."

Unsecured Cowling Detaches and Hits Tail

Cessna Citation 560L. Substantial damage. No injuries.

The flight crew was conducting a ferry flight from Bournemouth, England, where maintenance had been performed, to Biggin Hill the evening of June 29, 2008. While climbing through 7,000 ft, the crew heard a rumble and a thud at the rear of the aircraft, the AAIB report said.

"Due to a vibration in the control column, the autopilot was disconnected and a check of the flight controls was carried out," the report said. "No abnormalities were noted." The crew heard the rumble and thud again while descending through 3,000 ft but were able to land the Citation without further incident.

"After shutdown, an inspection of the aircraft revealed that approximately 75 percent of the left engine upper cowling had separated from the aircraft, damaging the leading edge of the fin and left elevator," the report said.

Investigators found that a maintenance technician had been interrupted while he was reinstalling the cowling. "This caused him to descend from the engine, but he had no recollection of climbing back up to the engine to secure the inboard fasteners," the report said. "A further 'panel refitment inspection' and a 'post-maintenance safety check' failed to identify that the inboard leading edge cowling fasteners had not been secured."

TURBOPROPS

Spatial Disorientation on a Dark Night

Beech King Air E90B. Destroyed. Five fatalities.

Night VMC prevailed when the King Air departed from Ruidoso, New Mexico, U.S., for an emergency medical services (EMS) flight to Albuquerque, about 110 nm (204 km) northeast, on Aug. 5, 2007. Witnesses said that the airplane turned left, toward the north, shortly after takeoff from Runway 06, which is at an elevation of 6,814 ft. The King Air did not arrive in Albuquerque on schedule, and a search was initiated at 2200 local time, the NTSB report said.

The wreckage was found at 0500 the next morning 4 nm (7 km) southeast of the Ruidoso airport. The report said that the airplane was descending at an angle of 13 degrees when it struck trees and crashed on a hill at an elevation of 6,860 ft. The patient, patient's mother, flight nurse, paramedic and pilot were killed.

Examination of the wreckage indicated that the engines were producing medium to high power, and that the landing gear and flaps were retracted on impact. "There was no evidence of any pre-impact mechanical malfunction," the

Considerable levels of residual magnetism were found within the compressor bearing.

report said. "The impact damage to the airplane, presence of dark night conditions, experience level of the pilot and anomalous flight path are consistent with spatial disorientation."

The pilot held an airline transport pilot certificate and had 2,775 flight hours, including 2,239 hours in multiengine airplanes, 23 hours in the King Air and 439 hours at night. He had flown a Cessna 414A for the EMS operator before being upgraded to King Air captain in April 2007.

"Toxicology testing detected chlorpheniramine, an over-the-counter antihistamine that results in impairment at typical doses, and acetaminophen, an over-the-counter pain reliever and fever reducer often known by the trade name Tylenol," the report said. It noted, however, that the investigation was unable to determine either when the pilot used these medications or the extent to which they might have impaired his performance during the flight.

Lightning Strike Linked to Engine Failure

Cessna 441 Conquest II. Substantial damage. No injuries.

The Conquest was cruising at Flight Level 210 (approximately 21,000 ft) during a scheduled flight with three passengers from Port Augusta, South Australia, to Adelaide the morning of July 25, 2007, when the right engine failed. The pilot secured the engine, advised ATC of the problem and received clearance to descend to 9,000 ft. He landed the aircraft at Adelaide without further incident, the ATSB report said.

Examination of the engine revealed that the bearing at the front of the compressor section had failed catastrophically due to severe mechanical and thermal distress. "That bearing provided both axial and lateral support for the turbine section," the report said. "Once that support was lost, the engine's rotating turbine section shifted forward under the influence of thrust loads, resulting in rotor-to-case contact and rapid engine failure."

Investigators found that an inspection of the Conquest had been performed after a suspected in-flight lightning strike two months before the accident. "The inspection did not reveal any obvious electrical damage at that time," the report said. "However, considerable levels of residual magnetism were found within the compressor bearing and other engine components during the ATSB examination. Such levels indicated that direct electrical current from an aircraft lightning strike had passed through the engine during service. The passage of such currents resulted in undetected electrical damage and led to the eventual failure of the compressor bearing."

Magnetic chip detectors were installed in the propeller reduction gearboxes in both of the 441's engines and were checked during scheduled maintenance, but they were not connected to a cockpit warning device. "Although the fitment of such devices is not mandatory, had the aircraft been equipped with an electrically connected engine chip detector system, it is likely that the pilot would have had advanced warning of an impending engine failure," the report said.

'Lapper' Dies in Survivable Accident

Socata TBM 700. Substantial damage. One fatality, two minor injuries.

The private pilot, who had 5,688 flight hours, including 4,388 hours in his single-turboprop airplane, was participating in a voluntary program to transport medical patients. Light southeasterly winds prevailed when he landed the airplane on Runway 30 at Iowa City (Iowa, U.S.) Municipal Airport the morning of June 3, 2008, to pick up a patient and her mother for a flight to Decatur, Alabama.

The airplane was on the ground only about 30 minutes, but wind velocity had increased to 23 to 36 kt when the pilot began the takeoff from the 3,900-ft (1,189-m) runway, the NTSB report said. The TBM 700 was about 3,000 ft (914 m) down the runway when the pilot initiated rotation and was about 30 ft above the runway when it stalled, banked left and crashed in the parking lot of an office building.

"Although the accident was survivable (both the pilot and the adult passenger survived with non-life-threatening injuries), an autopsy performed on the child [the patient] revealed that the cause of death was blunt force trauma of the head," the report said.

The pilot and the patient's mother had fastened their seat belts and shoulder harnesses, but the patient, who was two years and 10 months old, was held on her mother's lap. "She stated that she held her daughter because her daughter could not fit into the airplane seat if there was a shoulder harness present," the report said. U.S. Federal Regulations allow children to be held in the lap of an adult passenger during takeoff only until they reach the age of two.

The probable causes of the accident were "the pilot's improper decision to depart with a pre-existing tail wind and failure to abort the takeoff," the report said. "Contributing to the severity of the injuries was the failure to properly restrain the child passenger."

PISTON AIRPLANES

No Safeguards for Baggage-Door Latch

Piper Chieftain. Destroyed. Six fatalities, three serious injuries, one minor injury.

A passenger told investigators that the nose baggage door opened partially when the Chieftain lifted off the runway at Kodiak, Alaska, U.S., the afternoon of Jan. 5, 2008, for a charter flight to Homer. The door then opened fully when the pilot began a right turn in an attempt to return to the airport, the NTSB report said.

"With the airplane operating at a low airspeed and altitude, the open baggage door would have created additional aerodynamic drag and further reduced the airspeed," the report said. "The pilot's immediate turn toward the airport, with the now fully open baggage door, likely resulted in a sudden increase in drag, with a substantive decrease in airspeed and an aerodynamic stall."

The airport traffic controller saw the airplane roll sharply right and descend rapidly into the Pacific Ocean about 600 ft (183 m) offshore. The Chieftain quickly sank in 10 ft (3 m) of water. The pilot and five passengers were killed. The four survivors were rescued by the pilot of a float-equipped de Havilland Beaver.

The report said that the probable cause of the accident was "the failure of company maintenance personnel to ensure that the airplane's nose baggage door latching mechanism was properly configured and maintained" and that a contributing factor was "the lack of information and guidance available to the operator and pilot regarding procedures to follow should a baggage door open in flight."

The baggage door is on the left side of the airplane's nose, in front of the pilot's windshield. "When the door is opened, it swings upward and is held open by a latching device," the report said. "To lock the baggage door, the handle is placed in the closed position and the handle is then locked by rotating a key, engaging the locking cam. With the locking cam in the locked position, removal of the key prevents the locking cam from moving." The key cannot be removed unless the locking cam is engaged.

However, the locking mechanism on the accident airplane's baggage door had been replaced with an unapproved thumb-latch device, and the plastic guard inside the baggage compartment, which protects the door's locking mechanism from contact with baggage, was not in place. Interviews with other Chieftain operators revealed that many of them also had replaced the original baggage door locks with a latching device that does not require a key.

"In July 2008, Piper Aircraft issued a mandatory service bulletin (SB 1194, later 1194A) requiring the installation of a key lock device, mandatory recurrent inspection intervals, life limits on safety-critical parts … and the installation of a placard on the forward baggage door with instructions for closing and locking the door, to preclude an in-flight opening," the report said.

Faulty Gauges Factor in Fuel Exhaustion

Cessna 404. No damage. No injuries.

The pilot checked the 404's fuel gauges before departing from Beverley, South Australia, for a charter flight with three passengers to Adelaide the morning of Oct. 18, 2007. The gauges indicated that there were 400 lb (252 L) of fuel in the left tank and 350 lb (221 L) in the right tank. "Given the minimum fuel requirement for the flight to Adelaide was 640 lb (405 L), including reserves, the pilot considered that he had adequate fuel," the ATSB report said.

The aircraft was 102 km (55 nm) north of Adelaide at 7,500 ft when the right engine lost power. Attempts to restart the engine were unsuccessful. "There were no apparent anomalies, and the fuel quantity gauges were showing adequate fuel in each tank," the report said. "After securing the right engine, the pilot continued to Adelaide Airport and landed without further incident."

While examining the airplane, maintenance engineers drained 90 L of fuel from the left tank and 3 L from the right tank. However, the gauge for the right tank indicated that it held 150 lb (95 L) of fuel. "An engineer found that one of the electrical circuits in the right fuel quantity indication system had a high resistance," the report said. "After wiring in the circuit was repaired, the fuel quantity gauge correctly indicated zero fuel in the right tank. Calibration of the fuel quantity indication system was carried out, and during that process the left and right signal conditioners were found to be unreliable and were replaced or repaired."

The operator revised its procedures after the incident to require a secondary means of calculating fuel load before flight, to cross-check the fuel gauge indications.

HELICOPTERS

Gear Failure Prompts Autorotation

Eurocopter AS 350B1. Destroyed. One fatality, one serious injury.

The helicopter was being used to check for unauthorized excavation of terrain over underground natural-gas pipelines the afternoon of July 12, 2007. The pilot was circling at 400 ft AGL to give the observer a good view of road work near Ballynacally, Ireland, when the master caution light illuminated and the engine suddenly failed.

"The pilot lowered the collective and attempted to enter autorotation from a low level and over difficult and undulating terrain," the AAIU report said. The observer was killed and the pilot was seriously injured when the helicopter struck rising terrain.

Examination of the wreckage revealed that the 41-tooth bevel gear in the engine accessory gearbox had disintegrated due to fatigue, causing a loss of drive to the fuel control unit.

The accident helicopter's Turbomeca Arriel 1D engine was built in 1987 and had accumulated over 8,000 flight hours. The report said that as of the end of 2007, Arriel 1 and 2 engines worldwide had accumulated about 26 million flight hours, with nine reported failures of the 41-tooth bevel gear causing in-flight shutdowns or failed starts. In July 2008, the engine manufacturer issued a service bulletin announcing availability of a modified — thicker — gear that is more resistant to dynamic stresses.

Gusty Winds Cause Control Loss

McDonnell Douglas MD 500E. Destroyed. One fatality, one serious injury.

Thunderstorms were reported in the area when the pilot departed from his private helipad in Sunrise Beach, Missouri, U.S., for a brief local flight over a lake the afternoon of May 25, 2008. After flying for about four minutes, the pilot was conducting an approach to the helipad when the helicopter began to rapidly spin right. It spun four or five times before striking the water and sinking, the NTSB report said.

The passenger in the right front seat suffered a serious head injury but was able to exit from the helicopter. One of the three boys who were in the back seats drowned. "No passenger briefing was conducted, and none of the occupants were shown how to use their seat belts or doors, as required [by regulations]," the report said. "The victim, who was sharing a seat belt with another passenger, had never flown in the helicopter before and was unfamiliar with the exits and how to operate them."

The probable causes of the accident were "the loss of tail rotor effectiveness and the pilot's failure to regain aircraft control," the report said. "Contributing to the accident was the pilot's decision to fly in known adverse weather conditions and the gusty winds generated from convective outflow."

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
April 1, 2009	Kilshanchoe, Ireland	Schweizer 269C	destroyed	2 fatal
Visual meteorological conditions prevailed when the helicopter struck wires and crashed during a local flight from Weston.				
April 1, 2009	near Peterhead, Scotland	Eurocopter AS 332L2	destroyed	16 fatal
The Super Puma helicopter was en route from a North Sea platform to Aberdeen when the main rotor gearbox failed catastrophically and the rotor head separated 11 nm (20 km) offshore.				
April 2, 2009	San Miguel, Philippines	Britten-Norman Islander	destroyed	7 fatal
The Islander crashed in mountainous terrain during a scheduled flight from Tuguegarao to Maconacon.				
April 6, 2009	Gaborone, Botswana	Rockwell Aero Commander	destroyed	5 NA
The Aero Commander was on a scheduled flight from Kasane when it crashed on landing. No fatalities were reported.				
April 8, 2009	Cubiri de la Máquina, Mexico	Eurocopter AS 350B2	destroyed	3 fatal
The Ecureuil helicopter crashed after a mechanical failure occurred during a geological survey flight.				
April 8, 2009	Pittsville, Wisconsin, U.S.	Cessna 337 Skymaster	destroyed	1 fatal
The airplane was engaged in a forest-fire-fighting operation when it crashed in a field.				
April 9, 2009	Papua, Indonesia	British Aerospace 146-300	destroyed	6 fatal
The aircraft struck a mountain during its second approach to Wamena Airport.				
April 15, 2009	Shannon, Ireland	Boeing 767-300	none	168 none
The flight from Milan, Italy, to New York was diverted to Shannon after the captain became incapacitated by an apparent heart attack.				
April 17, 2009	Mount Gergazi, Indonesia	Pilatus PC-6 Turbo Porter	destroyed	11 fatal
The airplane struck a mountain during a scheduled flight from Ilaga to Mulia.				
April 17, 2009	Oakland Park, Florida, U.S.	Cessna 421B	destroyed	1 fatal
Witnesses said that the right engine was on fire when the 421 crashed in a residential area shortly after departing from Fort Lauderdale. No one on the ground was hurt.				
April 17, 2009	Canaima, Venezuela	Cessna 208B Grand Caravan	destroyed	1 fatal, 3 serious, 7 minor
The engine failed and the 208 crashed during takeoff for a scheduled flight to Porlamar.				
April 20, 2009	Phoenix, Arizona, U.S.	de Havilland Dash 8-200	substantial	17 none
A marshaller and wing walkers were guiding the airplane to a gate when its right propeller struck a ground power unit that had been positioned 7 ft (2 m) from its required parking spot.				
April 25, 2009	Bastia, France	Eurocopter EC 145	destroyed	5 fatal
The helicopter crashed in mountainous terrain during an air ambulance flight.				
April 25, 2009	Stockton, Utah, U.S.	Lockheed P2V-7 Neptune	destroyed	3 fatal
Low ceilings and restricted visibility prevailed when the fire bomber struck the top of a ridge at 5,630 ft during a repositioning flight for the U.S. Forest Service.				
April 26, 2009	San Juan, Puerto Rico	Douglas DC-3C	destroyed	5 none
The crewmembers evacuated when a fire erupted in the DC-3's cockpit while the cargo airplane was being taxied for departure.				
April 27, 2009	Guadalajara, Mexico	Boeing 737-200	substantial	116 NA
En route from Cancún, the flight crew observed no indication that the landing gear was down and locked during approach. After airport traffic controllers confirmed that the gear appeared to be retracted, the crew elected to land with the gear up. No fatalities or injuries were reported.				
April 27, 2009	Maracaibo, Venezuela	Boeing 737-200	substantial	84 NA
The flight crew reported hydraulic problems during departure and returned to the airport. The 737 overran the runway on landing. No fatalities were reported.				
April 28, 2009	Hamburg, Germany	Cessna 421C	destroyed	1 minor
Shortly after departing from Hamburg International Airport, the pilot reported that his navigation equipment had failed and that he was diverting to the Finkenwerder airport. Landing gear problems occurred during approach, and the pilot elected to ditch the 421 in the Elbe River.				
April 29, 2009	Massamba Village, Democratic Republic of Congo	Boeing 737-200	destroyed	7 fatal
The 737 crashed out of control during a ferry flight from Bangui, Central African Republic, to Harare, Zimbabwe, where maintenance was scheduled.				
April 30, 2009	Yakutia, Russia	Antonov An-2	destroyed	3 fatal
The biplane, which was on a ferry flight from Lensk, struck power lines on approach during the flight crew's third attempt to land in heavy snow and low visibility.				

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.

Selected Smoke, Fire and Fumes Events in the United States and Canada, January–March 2009

Event Date	Phase of Flight	Event Airport	Event Classification	Event Sub-Classification	Aircraft Model	Operator Name
Jan. 7, 2009	Climb	New York (LGA)	Return to airport, unscheduled landing	Smoke in cockpit	DC-9	American Airlines
At 15,000 ft, the captain's primary display went blank and smoke started entering the cockpit. The primary flight display was turned off but electrical smoke and fumes continued.						
Jan. 14, 2009	Climb	Portland, Oregon, U.S. (PDX)	Return to airport, unscheduled landing	Smoke in cockpit, smoke in cabin	DC-9	American Airlines
The crew reported smoke in the cabin and cockpit from an unknown source. Smoke began to dissipate, but smell and visible smoke were still present after landing.						
Jan. 14, 2009	Cruise	Moosonee, Ontario, Canada (YMO)	Diversion, emergency landing	Smoke in cabin	Beech 100	Corporate
Upon reaching cruise altitude, the crew noticed smoke in the cabin. The crew attempted to return to the departure airport but flaps would not extend on approach. The flight was diverted to YMO. The flap control circuit breaker tripped and the smoke in the cabin dissipated. The aircraft was landed safely with flaps up.						
Jan. 25, 2009	Climb	Fort Lauderdale, Florida, U.S. (FLL)	Return to airport, unscheduled landing	Smoke in cabin	EMB-190	JetBlue Airways
Climbing through 2,500 ft, the crew reported heavy fumes in the cabin. The airplane was returned to the airport of departure.						
Jan. 27, 2009	Cruise	Atlanta (ATL)	Diversion, emergency landing	Smoke in cockpit, Smoke in cabin	CL-600	Corporate
The crew reported a burning smell in the cockpit and cabin. A diversion to ATL followed, and an emergency landing was made without incident.						
Feb. 3, 2009	Climb	Orlando, Florida, U.S. (MCO)	Return to airport, unscheduled landing	Smoke in cockpit, smoke in cabin	EMB-190	JetBlue Airways
Fumes were detected in the cockpit and cabin, along with an acrid smell. Quick reference handbook procedures were accomplished.						
Feb. 7, 2009	Cruise	Denver (DEN)	Emergency landing	Smoke in cockpit	Boeing 727	Federal Express Corporation
At Flight Level 390, the crew smelled fumes in the cockpit. An emergency was declared, and the aircraft was landed.						
Feb. 13, 2009	Climb	Unknown	Return to airport, unscheduled landing	Smoke odor	EMB-190	Allegheny Airlines
On climbout through 8,000 ft, the autothrottle disconnected with "AT FAIL, "AOA LIMIT FAIL" and "TAT 1 FAIL" EICAS messages. Within minutes an electrical odor became evident in cockpit. An emergency was declared and the flight was returned to the departure airport.						
Feb. 15, 2009	Climb	Houston (IAH)	Return to airport	Smoke in cockpit, Smoke in cabin	EMB-145XR	Continental Express
The crew reported smoke in the cockpit and cabin after takeoff. The aircraft was returned to the departure airport and landed without incident.						
Feb. 28, 2009	Landing	Pittsburgh (PIT)	Emergency landing	Smoke in cabin	A319	Allegheny Airlines
Prior to landing, cabin lights were flickering, then powdery smoke was reported in cabin. An emergency was declared, and aircraft rescue and fire fighting responded.						
March 9, 2005	Descent	Unknown	Emergency landing	Smoke in cockpit	EMB-170	Corporate
On descent at about 10,000 ft, the crew noticed a smoke smell and debris coming out of the vents. The smell went away but came back more strongly at 4,000 ft. Debris from the vents sounded like insulation; the fan sounded like it was working very hard. The captain declared an emergency and landed without incident.						
March 22, 2005	Climb	Pittsburgh (PIT)	Return to airport, unscheduled landing	Smoke in cockpit, Smoke in cabin	EMB-145XR	Continental Express
The crew reported a "LAV SMOKE" warning after passing through 3,000 ft. An electrical burning smell was perceived in the cockpit and cabin. The aircraft was returned to the departure airport.						
March 23, 2005	Cruise	Unknown	Diversion, emergency landing	Smoke in cockpit	Boeing 737	Southwest Airlines
During cruise, a large volume of smoke appeared from the sliding window in the cockpit. An emergency was declared, followed by a diversion.						
March 27, 2005	Cruise	Spokane, Washington, U.S. (GEG)	Diversion, unscheduled landing	Smoke in cockpit	MD-10	Federal Express
Twenty minutes after takeoff, smoke and fumes were detected in the cockpit. They appeared to be electrical in origin. The quick reference handbook procedure for smoke/fumes was completed. The flight was diverted to GEG.						

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

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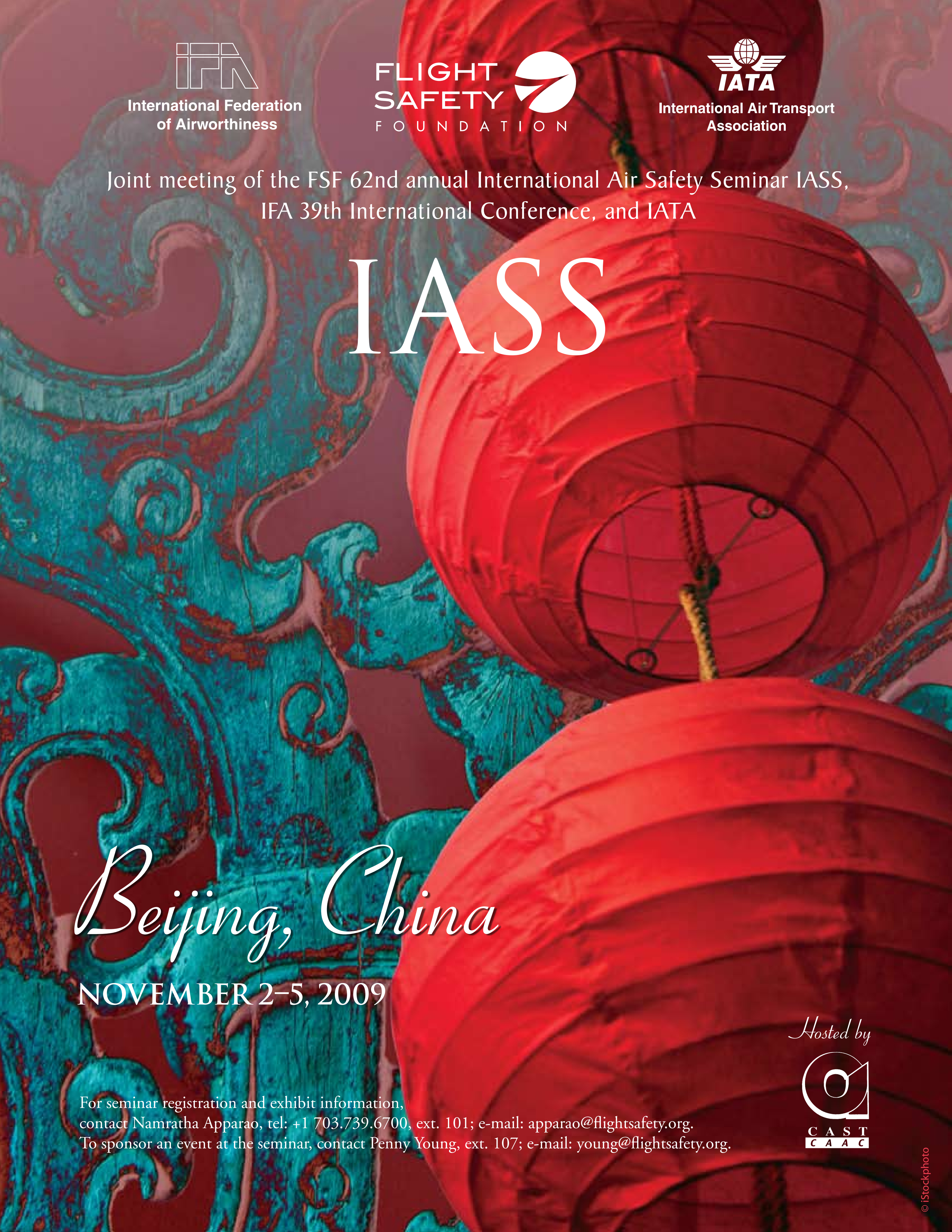
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