AeroSafety WORLD

EXCURSION DEFENSES
KEEP IT ON THE RUNWAY

OVERRUN PROTECTION
Improving runway safety areas

VITAL SOFTWARE UPDATES
Keeping TAWS/EGPWS current

AUCKLAND INCURSIONS
Confusion causes close calls

ICAO AUDIT RESULTS
Some opt for short form

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

AUGUST 2008

Wright Flyer photo/source: U.S. National Aeronautics and Space Administration

RULES VERSUS Safety

I spend quite a bit of my time trying to explain modern safety concepts to a lot of important people. Many of them do not know aviation and have never contemplated the realities of human error. Gaining their comprehension is often an uphill battle, and I am beginning to realize that it is because I am glossing over a critical point that people often do not grasp: Compliance does not equal safety. The people who govern us assume that good rules and quick punishments can actually prevent crashes.

I guess we shouldn't be surprised; many of these people are in the "rules and punishment" business. Politicians get elected by being tough and demanding accountability. Reporters look for situations where rules are overlooked and they label it as corruption. Prosecutors enforce the rules with the heartfelt belief that rules will save lives if the right people are punished.

It is difficult to persuade these people that compliance can only take us so far. It sounds like a "sellout" to industry, even though it is really our best hope. It is an even worse problem for regulators who are trying to sell safety management systems. They live in a political world, and no politician expects to win popular approval by supporting voluntary reporting.

So let's take this issue on directly.

First, we have to acknowledge that while compliance with rules is important, it is not enough. If compliance guaranteed safety, we would only need one rule: "Don't crash." Obviously, it takes a lot more than that.

We have been writing rules in the name of safety for a long time, and that road has become a dead end. When I had to make the argument for a safety management system standard at the International Civil Aviation Organization (ICAO), I pointed out that the ICAO audit team had identified more than 10,000 international standards that states had to translate into local law. When the team counted all of the other recommendations and technical specifications that needed to be considered, the number of rules swelled to 30,000.

That's a lot of rules. I asked the question, "If we write another 1,000 standards, will it make things safer?" The consensus of the countries around the world was "probably not," and that more rules wouldn't necessarily give us more safety. It was time to look toward better safety reporting and better safety systems.

The international aviation community gets the point, but the rest of the world needs convincing. They need to understand that by taking on things like safety management, reporting systems and risk management, we are not turning our back on the rules. Rather, we are simply moving beyond them. Compliance is still important, but we can no longer allow compliance to lull us into complacency. We must continue looking for the next risk, the next potential error, whether it involves a rule or not.

I ask all of you to help us do a better job of communicating our intent to those in power and those in the news media. We are not an industry trying to free ourselves from regulations; we are an industry trying to free ourselves from the dangerous illusion that regulations are enough.

William R. Voss
President and CEO
Flight Safety Foundation

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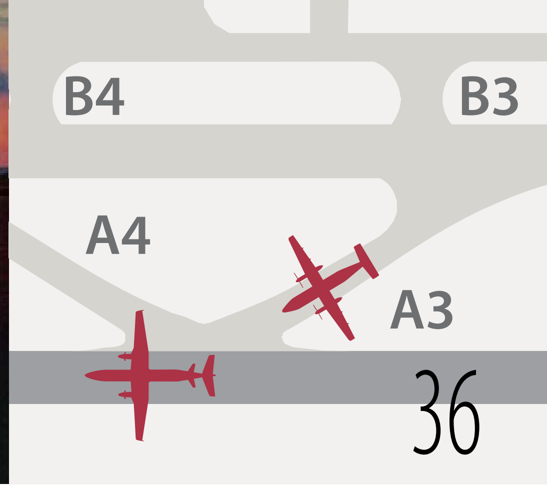

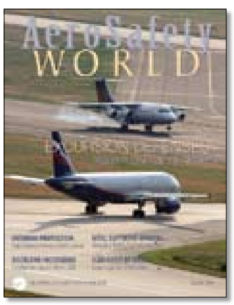

About the Cover
Runway Safety Initiative attacks excursions.
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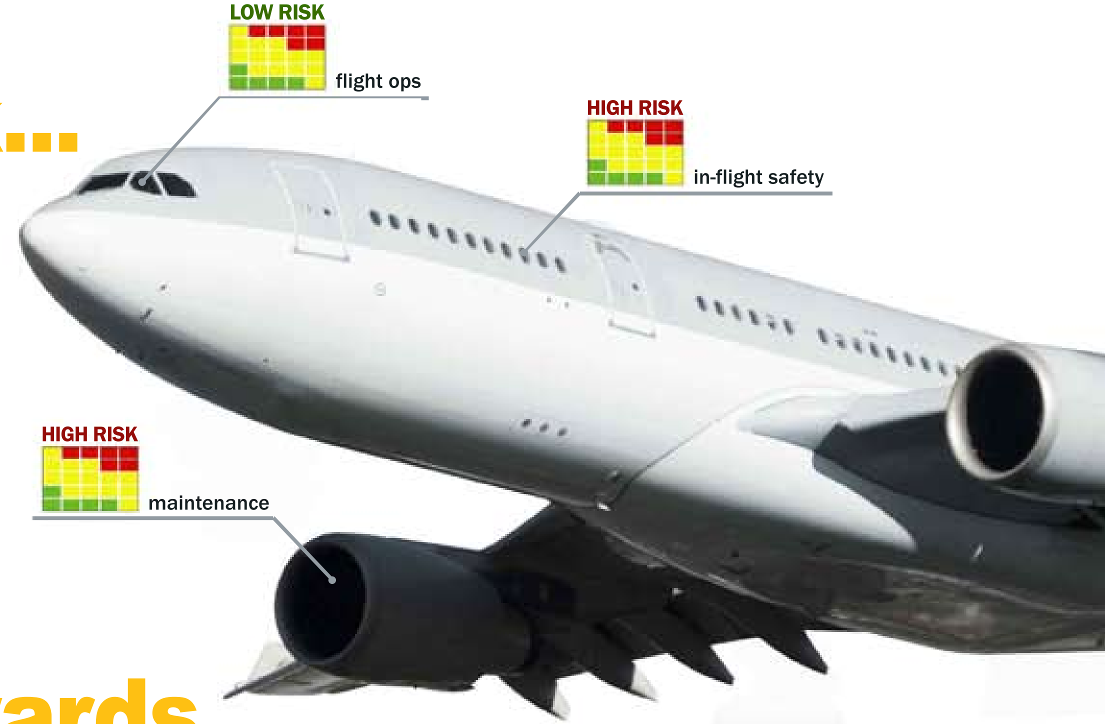

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TIME TO Reboot

The recent spate of accidents involving similar types of aircraft — jet freighters and emergency medical services helicopters — is an unwelcome return to the time when accidents seemed to come in clusters, making headlines and scaring customers and regulators with the appearance of an aviation safety meltdown.

It is far too early to say for certain if these accidents have any common threads, but it isn't too early to begin devising broad-based campaigns to elevate the status and effectiveness of safety programs in the impacted segments, and maybe beyond.

Such safety initiative enhancements must start with the specific companies that have suffered losses. They must deal with actual failures, not theories of increased risk based on statistical analyses, and herein lies a threat. It will be very tempting to turn post-accident efforts into a "hard target" operation and define success as making sure that the particular accident doesn't happen again. While this aspect certainly should be attended to, if the effort ends there with a declaration of victory, this would be a return to past practices that gave rise to the criticism that regulatory agencies were involved in "tombstone" regulation, acting only after an accident, responding only to that accident.

Aviation safety professionals and most regular readers of this publication know I'm now going to say that the involved companies should move beyond the accident specifics and conduct a top-to-bottom assessment of their corporate culture and the place safety has in it. If there are questions about where to start, many find great benefit from an independent audit of their operation that stakes out in very clear terms both the starting point and a goal.

Next in line are the industry segment leaders who should guide a wider effort to realign safety initiatives to better address accidents and incidents that point to poor practices.

Other operators in those segments are cautioned to avoid the "it didn't happen to us" mindset that assumes that the absence of accidents is solid proof that you do not have a safety problem. Even if operations are safe, I believe a wise course of action is for operators to take the poor outcomes of others as a signal that it is time to rededicate and reinvigorate their own programs. And, importantly, this periodic rededication should extend beyond the affected segments.

This is really the main point of this month's rant: Safety programs are not perpetual-motion machines. Eventually, they run down and lose the dynamism that made them so successful, the safety rhetoric becomes stale and overly familiar, and staff focus weakens. To borrow a metaphor from the computer world, every now and then any safety program must be rebooted, pulled down, taken apart, old files dumped and then reassembled to address today's threat environment and changes that are now on the horizon but were not apparent when the program was first envisioned.

Of course, this is not to say that a program with good continuous improvement dynamics will inevitably become fatally weakened. But even the best programs can benefit from an occasional overhaul, just to be on the safe side.

J.A. Donoghue

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

FLIGHT SAFETY FOUNDATION

Serving Aviation Safety Interests for More Than 60 Years

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

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AUG. 11–14 ➤ 2008 Air Safety and Security Week. Air Line Pilots Association, International. Washington, D.C. <crewroom.alpa.org/SAFETY/Default.aspx?tabid=2427>, +1 703.689.2270.

AUG. 14–16 ➤ Latin American Business Aviation Conference and Exhibition (LABACE) 2008. National Business Aviation Association and ABAG–Brazilian Association of General Aviation. São Paulo, Brazil. <www.labace.com.br/ing/statics.php>.

AUG. 17–19 ➤ ALA Aeronautical Convention and Exhibition. Latin American Aeronautical Association. Miami. <ala@ala.aero>, <www.ala-internet.com>, +1 817.284.0431.

AUG. 18–21 ➤ 10th Bird Strike Committee USA/Canada Meeting. American Association of Airport Executives and Bird Strike Committee USA/Canada. Orlando, Florida, U.S. Christy Hicks, <christy.hicks@aaae.org>, <www.aaae.org/products/meeting_details.html?Record_id=566>.

AUG. 19–21 ➤ Wichita Aviation Technology Congress & Exhibition. SAE International. Wichita, Kansas, U.S. <CustomerService@asae.org>, <www.sae.org/events/watc>, 877.606.7323, +1 724.776.4970.

SEPT. 3–4 ➤ 20th FAA/ATA International Symposium on Human Factors in Maintenance and Ramp Safety. U.S. Federal Aviation Administration and Air Transport Association of America. Orlando, Florida, U.S. <www.airlines.org/operationsandsafety/events/2008hfsymposium.htm>.

SEPT. 4 ➤ De/Anti-Icing Seminar. National Air Transportation Association. Boise, Idaho, U.S. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1661>.

SEPT. 7–11 ➤ 56th International Congress of Aviation and Space Medicine. Institute of Aviation Medicine, Royal Thai Air Force. Bangkok, Thailand. <icasm2008@gmail.com>, <www.icasm2008.org/welcome.html>, +66 (0)2714 2590-1, ext. 13, 15.

SEPT. 8–11 ➤ ISASI 39th Annual Seminar: Investigation: The Art and the Science. International Society of Air Safety Investigators. Halifax, Nova Scotia, Canada. <www.isasi.org/isasi2008.html>.

SEPT. 10–11 ➤ Crisis Preparedness Conference and Aeropolitical Conference for Legal Issues Facing the Aviation Industry. Latin American Air Transport Association (ALTA). Miami. Valerie Garcia, <vgarcia@alta.aero>, <www.alta.aero/crisispreparedness>, <www.alta.aero/aviationlaw>, +1 786.522.7824.

SEPT. 10–11 ➤ 8th Annual CIS, Central and Eastern European Airline Engineering and Maintenance Conference. Aviation Industry Group. Prague, Czech Republic. Lucy Ashton, <lucya@aviation-industry.com>, <www.aviationindustrygroup.com/index.cfm?pg=306&archive=false&offset=1>, +44 (0)207 931 7072.

SEPT. 15–18 ➤ Flight Simulator Engineering and Maintenance Conference. ARINC. Salt Lake City. Sam Buckwalter, <sbuckwal@arinc.com>, <www.aviation-ia.com/fsemc>, +1 410.266.2008.

SEPT. 16 ➤ De/Anti-Icing Seminar. National Air Transportation Association. Cleveland. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1701>.

SEPT. 16–17 ➤ Asia Pacific Aviation Training Symposium (APATS): Training for Safety in a Commercial World. Halldale Media. Bangkok, Thailand. Chris Long, <chrislong@halldale.com>, <http://www.halldale.com/APATS.aspx>, +44 (0)1252 532000.

SEPT. 16–19 ➤ 34th European Rotorcraft Forum. Council of European Aerospace Societies and the Royal Aeronautical Society. Liverpool, England. <raes@raes.org.uk>, <www.aerosociety.com/cmspage.asp?cmsitemid=ConferenceAndEvents_ERF34>, +44 (0)20 7670 4300.

SEPT. 22–25 ➤ 51st annual Non-Destructive Testing Forum. Air Transport Association of America. Seattle. <www.airlines.org/operationsandsafety/events/2008+NDT+Forum+Web+site.htm>.

OCT. 4–5 ➤ Flight Operations Manual Workshop: Employing the International Standard for Business Aircraft Operations. National Business Aviation Association. Orlando, Florida, U.S. Sarah Dicke, <sdicke@nbaa.org>, <web.nbaa.org/public/cs>, +1 202.783.9000.

OCT. 6–8 ➤ 61st Annual Meeting and Convention. National Business Aviation Association. Orlando, Florida, U.S. Donna Raphael, <draphael@nbaa.org>, <web.nbaa.org/public/cs/amc/2008>, +1 202.783.9000.

OCT. 7–9 ➤ Aircraft Accident Investigation Course. University of North Dakota Aerospace Foundation and Air Line Pilots Association, International. Grand Forks, North Dakota, U.S. Frank Argenziano, <argenzia@aero.und.edu>, +1 701.777.7895.

OCT. 8–9 ➤ 3rd Aviation Emergency Response Conference. Association of Asia Pacific Airlines. Hong Kong. <www.aapairlines.org/AAPA_3rd_Aviation_Emergency_Response_Conference.aspx>.

OCT. 9 ➤ Maintenance Manual Workshop. National Business Aviation Association. Orlando, Florida, U.S. Donna Raphael, <draphael@nbaa.org>, <web.nbaa.org/public/cs>, +1 202.783.9000.

OCT. 15–18 ➤ 25th International Meeting of Aerospace Medicine. Mexican Association of Aviation Medicine and the Iberoamerican Association of Aerospace Medicine. Zacatecas, Mexico. Luis A. Amezcua Gonzales, M.D. <lamezcua@att.net.mx>, <www.amma.org.mx>, +52-55 55.23.82.17.

OCT. 20–22 ➤ Air Medical Transport Conference. Association of Air Medical Services. Minneapolis. <www.aams.org/AM/Template.cfm?Section=Education_and_Meetings>, +1 703.836.8732.

OCT. 21 ➤ Accident Prevention via Human Factors Training. National Air Transportation Association. San Diego. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1582>.

OCT. 23–24 ➤ 5th Flight Safety Seminar on Confidential Report Systems. Spanish Professional Pilot Association (COPAC). Madrid. <comunicacion1@copac.es>, <www.copac.es>, +34 91 590 02 10.

OCT. 27–30 ➤ International Air Safety Seminar (IASS). Flight Safety Foundation, International Federation of Airworthiness and International Air Transport Association. Honolulu. Namratha Apparao, <apparao@flightsafety.org>, +1 703.739.6700, ext. 101.

OCT. 27–29 ➤ 46th Annual Symposium. SAFE Association. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3012.

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.

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October 27–30, 2008

Joint Meeting of FSF 61st annual International Air Safety Seminar, IFA 38th International Conference, and IATA

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FSF, Eurocontrol and ERA
21st annual European Aviation Safety Seminar

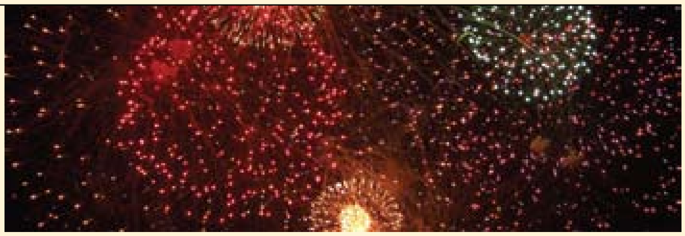
Hilton Cyprus Hotel, Nicosia, Cyprus

CASS 2009

April 21–23, 2009

FSF and NBAA
54th annual Corporate Aviation Safety Seminar

Hilton Walt Disney World, Orlando, Florida



Send information: ❑ **EASS** ❑ **CASS** ❑ **IASS** (joint meeting: FSF, IFA and IATA) ❑ **FSF membership information**

Fax this form to Flight Safety Foundation, +1 703.739.6708. For additional information, contact Ann Hill, +1 703.739.6700 ext.105; e-mail: hill@flightsafety.org.

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Safety News

Quality Assurance Programs Sought

Helicopter air tour operators should establish systems for the continuous analysis of the performance and effectiveness of their inspection and maintenance programs and provide model-specific training for their maintenance personnel, the U.S. National Transportation Safety Board (NTSB) says.

In a series of recommendations to the U.S. Federal Aviation Administration (FAA) and the Tour Operators Program of Safety (TOPS), the NTSB also called for the FAA to work with TOPS and other safety programs to establish guidance on the development and implementation of inspection and maintenance quality assurance programs.

The NTSB's recommendations followed the preliminary investigation of the fatal March 8, 2007, crash of a Heli-USA Airways Aerospatiale AS 350BA in Princeville, Hawaii, U.S. The pilot had reported hydraulic problems shortly before the crash and said that he planned to perform a run-on landing at Princeville Airport, the NTSB said. As he flew toward the airport, the helicopter became uncontrollable, the main rotor blades struck the ground, and the helicopter broke into several pieces. The pilot and three passengers were killed in the crash; the three other passengers were seriously injured. The investigation was continuing.

The NTSB also cited the Sept. 11, 2002, hydraulic failure of an Aerospatiale AS 350BA, also operated by Heli-USA, during its return from the Grand Canyon to McCarran International Airport in Las Vegas. The pilot diverted the helicopter to Grand Canyon West Airport in Peach Springs, Arizona. The helicopter was substantially damaged in the hard landing, and one passenger received minor injuries. The NTSB said that the probable cause of that accident was the pilot's "failure to maintain adequate airspeed and main rotor speed during the landing approach, as prescribed in the hydraulic pump failure emergency procedures found in the rotorcraft flight manual." A

© Heli-USA Airways

contributing factor was "the failure of the hydraulic pump due to excessive coupling spline wear, which was caused by the application of insufficient lubrication by the operator's maintenance personnel during pump installation."

The NTSB said that the investigation revealed safety issues related to the operator's "ineffective maintenance, inadequate quality assurance programs, model specific maintenance training and the … FAA's lack of surveillance … to identify maintenance nonconformance."

Similar issues were found in other air tour operators' maintenance programs, the NTSB said.

Surge in Bird Strike Reports

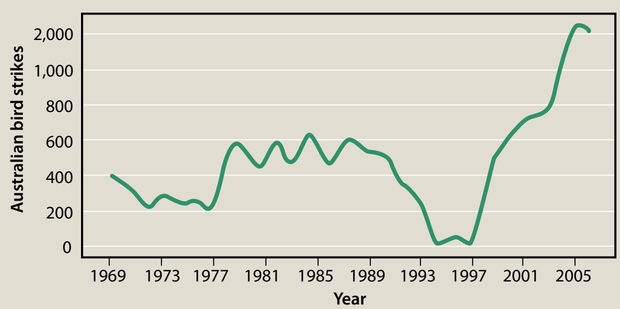
The number of bird strikes reported annually in Australia increased 60 percent between 2002 and 2006, although damaging bird strikes remained rare, according to a report by the Australian Transport Safety Bureau (ATSB).

Some 5,103 bird strikes were reported during the five-year period; of that number, 383 bird strikes, or 7.5 percent, were described as damaging strikes. "More importantly, bird strike events resulting in two-engine ingestion that have the potential to lead to an accident are even rarer at 0.15 percent (eight of 5,103)," the report said.

The rate of bird strikes per 10,000 aircraft movements increased from about one in 2002, when 750 bird strikes were reported, to two in 2006, when 1,200 strikes were reported. However, the rate of damaging bird strikes has remained the same since the 1980s, the report said.

The report attributed the increased number of reported bird strikes to several factors, including an increase in aircraft movements; the establishment in 2003 of the Australian Animal Wildlife Hazard Group, which disseminates information about bird strikes and encourages the reporting of strikes; and changes in the people and systems that report strikes.

Reported Australian Birdstrikes, 1969 to 2006



Source: Australian Transport Safety Bureau

Analysis of bird strike data dating to 1969 indicated that reporting of strikes has varied because of changes in perceptions of the importance of reporting, resources and legislation, the report said.

"The evidence for the increased reporting being responsible for the change in the number of bird strikes recorded is likely, rather than a change in the actual number of bird strikes," the report said.

Crashes Prompt Calls for EMS Safety

Six crashes in two months involving emergency medical services (EMS) helicopters operated in the United States — including a midair collision of two Bell 407s on approach to the same hospital helipad — has prompted the association representing the air medical transport industry to call for a "rolling safety stand down."

The Association of Air Medical Services says the action would allow for a renewed emphasis on safety while EMS operators continue to provide patient services.

The association, which planned a daylong safety summit in late July aimed at identifying strategies for improving the safety culture for EMS operations, also has reiterated its support for legislation and regulatory changes to "promote a safe transport environment" for patients and crewmembers.

U.S. Federal Aviation Administration (FAA) data show that the number of helicopter EMS accidents nearly doubled between the mid-1990s and a rapid growth period from 2000 to 2004, the year that the FAA began a government-industry partnership aimed at safety culture improvements.

The FAA says that "significant short-term safety gains" could result from actions such as risk-management training for flight crews and better use of night vision goggles and other technological advances.

© Bell Helicopter

Safety Pact

The European Union and the United States have formally agreed to a plan to improve aviation safety and reduce related costs.

The safety agreement, signed by Antonio Tajani, European Commission (EC) vice president for transport, and Robert Sturgell, acting administrator of the U.S. Federal Aviation Administration (FAA), calls for mutual recognition of aviation safety certificates.

It also provides for "the exchange of information on safety findings, including aircraft design and manufacturing, continued airworthiness and repair station oversight," the FAA said.

"The agreement will result in better harmonized safety systems on both sides of the Atlantic, as well as less cumbersome technical and administrative procedures for the recognition of certificates," the European Commission said. "It is expected that this will entail further improvement in safety levels and reduce costs by several millions of euros every year for European and U.S. manufacturers alike. These savings should in turn be reflected in fares for passengers."

A bilateral board will oversee implementation of the agreement; the board also will serve as a forum for discussion of safety issues.

Fire Fighting Foam

The U.K. Civil Aviation Authority (CAA) has begun an international research effort to improve the fire fighting foams used against aircraft fires.

Recent developments in chemical research may now allow for foams that could be used in smaller quantities, which could result in lighter-weight and more efficient fire fighting vehicles, the CAA said.

"This has the potential to enhance safety significantly and benefit the aviation industry and the traveling public," said Simon Webb, an airport fire specialist in the CAA Safety Regulation Group.

The goal is to develop foam-testing methods that will allow the production of foam that complies with new international regulatory standards. Existing standards were developed in the 1970s.

The research is being conducted on behalf of the International Civil Aviation Organization and funded by the CAA and Transport Canada.

Sgt John Jung/U.S. Air Force

FAA Faulted for Oversight Lapses

The U.S. Federal Aviation Administration (FAA) showed "serious lapses" in air carrier oversight when it "developed an overly collaborative relationship" with Southwest Airlines, according to a preliminary report by the U.S. Department of Transportation Inspector General (IG).

The report, which presents interim results of a review requested by the chairman of a congressional committee, said that the FAA inspection office overseeing Southwest repeatedly allowed the airline to self-disclose violations of airworthiness directives (ADs). Self-disclosure allows operators to avoid penalties for their actions.

The report said that, according to Southwest, the airline "discovered [on March 14, 2007,] that it had violated the AD requiring fuselage inspections … and notified an FAA principal maintenance inspector (PMI) the following day. Although FAA requires air carriers to ground noncompliant aircraft and [requires] its inspectors to ensure that carriers comply, the inspector did not direct [Southwest] to ground the 46 affected aircraft."

The airline operated the noncompliant aircraft on 1,451 flights over eight days after notifying the FAA of the problem — and operated them in violation of the AD for as long as nine months, the report said.

The FAA has begun addressing the Southwest violation with a review of AD compliance at the airline, and at other air carriers, and with proposals to fine Southwest more than US$10 million. The agency says that it agrees with the IG's findings in "virtually every area" and has begun implementing many of the recommendations included in the report.

© Southwest Airlines

The recommendations include implementation of management controls over the voluntary disclosure reporting program such as implementing and enforcing "a process for second-level supervisory review of self-disclosures before they are accepted and closed — acceptance and closure should not rest solely with one inspector."

U.S. National Transportation Safety Board

Investigators are trying to determine the cause of the fire that burned through the top of this ABX Air Boeing 767 cargo airplane while it was parked at San Francisco International Airport. The fire broke out just behind the cockpit as the two-member crew was about to start the engines. Both crewmembers escaped without injury, and the airplane received substantial damage from the blaze, the U.S. National Transportation Safety Board said.

In Other News …

President Omar al-Bashir of **Sudan** has grounded all Antonov and Ilyushin aircraft, except for military airplanes, and removed the head of the Civil Aviation Authority (CAA) following four fatal crashes in two months, published reports said. … The International Federation of Air Line Pilots' Associations (IFALPA) and the International Air Transport Association (IATA) are conducting an assessment of "communication availability and reliability in **Africa** as a provision for RVSM [reduced vertical separation minimum] implementation." RVSM allows for the reduction of vertical separation from 2,000 ft to 1,000 ft above Flight Level 290 (approximately 29,000 ft). … A survey conducted for the Civil Aviation Safety Authority of **Australia** says 78 percent of Australians are "completely confident" or "very confident" about safety on flights between Australian capital cities.

Compiled and edited by Linda Werfelman.

Aviation safety experts aim for the Runway Safety Initiative to provide the tools to help prevent runway excursions.

SAFETY ON THE Straight and Narrow

BY LINDA WERFELMAN

All five crewmembers survived the runway excursion crash of this Kalitta Air 747 on takeoff from Brussels Airport in May.

Runway excursions comprise 96 percent of all runway accidents, 80 percent of fatal runway accidents and 75 percent of related fatalities (Table 1, p. 14). Nevertheless, although these accidents have been the subject of a few studies, the number has been relatively small, and the recommended preventive measures have been relatively few, compared with numerous programs devoted to runway incursions, which account for less than one accident a year.

The Runway Safety Initiative (RSI), an international effort involving about 20 participants — including regulatory authorities and investigative agencies, industry groups and aircraft manufacturers — and coordinated by Flight Safety Foundation, is designed to intensify the attention being focused on all runway safety issues but especially on runway excursions.

The RSI defines a runway safety issue as "any safety issue that deals with the runway environment (or any surface being used as a runway) and the areas immediately adjacent to it [such as runway end safety areas and high-speed taxiways]." Runway safety issues include runway incursions, runway excursions and the inappropriate use of runways — a category sometimes referred to as runway confusion.

Runway excursions include events of two types: veer-offs, in which an aircraft goes off the side of a runway, and overruns, in which an aircraft runs off the end of a runway.

"Runway excursion accidents are not rare events," said James M. Burin, FSF director of technical programs. "Many don't involve much damage and there are no injuries, some are serious and involve substantial damage, and a few are deadly."

In most instances, a runway excursion is "not a total surprise" to the flight crew, Burin said. "We have proven several times each year that, if you land long and fast, with a tailwind, on a contaminated runway, the consequences are predictable."

Among the recent examples:

- The July 17, 2007, crash of a TAM Linhas Aéreas Airbus A320, which overran Runway 35L at Congonhas Airport in São Paulo, Brazil. Preliminary reports said that weather conditions included rain and the asphalt runway was wet; that the airplane's right thrust reverser was not serviceable; and that the runway had been resurfaced shortly before the accident but had not been grooved. All 187 people in the airplane, and 12 on the ground, were killed, and the airplane was destroyed.[1]
- The March 7, 2007, crash of a Garuda Indonesia Boeing 737-400 at Yogyakarta, Indonesia. The airplane crossed the runway threshold at 232 kt — 98 kt faster than the landing reference speed — and touched down at 221 kt about 860 m (2,822 ft) from the threshold of the 2,200-m (7,218-m) runway. Twenty-one of the 140 people in the airplane were killed and 12 received

serious injuries; the airplane was destroyed.[2]

- The July 9, 2006, crash of an S7 Airlines A320 at Irkutsk Airport in Russia. The airplane had been released for the flight with six minimum equipment list (MEL) defects, including a deactivated left engine thrust reverser. After the airplane touched down on the wet runway, the captain "inadvertently … moved the throttle lever for the left engine … from the 'idle' [position] to the significant forward thrust position," the accident report said. "Inadequate monitoring and callouts of airplane speed and engine parameters by the copilot made it impossible for the crew to perform the necessary actions, either by moving the left throttle back to idle or shutting down the engines." The airplane overran the runway, struck a concrete fence and buildings and burned; 125 of the 203 people in the airplane were killed.[3]
- The Dec. 8, 2005, crash of a Southwest Airlines 737-700 at Chicago Midway International Airport in snow and freezing fog. The U.S. National Transportation Safety Board (NTSB) cited both the slippery runway and the tailwind component of more than 5 kt, as well as the delayed application of reverse thrust, in its final report on the accident, which killed one person on the ground and seriously injured another. The airplane was substantially damaged.[4]

News reports have described several excursion accidents in recent months, including a June 10 crash involving a Sudan Airways A310, which overran a runway while landing in Khartoum

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Runway Safety Accident Data, 1995–2007

	Number of Accidents	Percent of Total Accidents[1]	Number of Fatal Accidents	Number of Onboard Fatalities
Incursions	10 (0.8/year)	0.7%	5	129
Excursions	379 (29.1/year)	28.5%	31	680
Confusion	4 (0.3/year)	0.3%	2	132

1. 1,332 total accidents

Source: Flight Safety Foundation

Table 1

amid thunderstorms. Reports were incomplete but indicated that at least 29 — and possibly more — of the approximately 250 people in the airplane were killed and the airplane was destroyed.[5]

In a May 25 runway excursion, a Kalitta Air 747-200 cargo flight crashed not on landing but on takeoff from Brussels Airport in Belgium. Reports said that crewmembers heard one or two loud bangs during the takeoff run before the airplane overran the 9,800-ft (2,989-m) runway and broke into three pieces. All five crewmembers — the only people in the airplane — survived; the airplane was destroyed.[6]

An April 15 runway excursion accident involving a Hewa Bora Airlines Douglas DC-9 occurred on takeoff from Goma, Democratic Republic of the Congo. One report said that the captain applied the brakes after experiencing engine trouble, and the airplane skidded off the wet runway, which had been damaged — and shortened — because of lava flow from a nearby volcano during a 2002 eruption. At least 37 people, most of them on the ground, were killed in the crash, which destroyed the airplane.[7]

Burin said that the severity of runway excursion accidents depends primarily on the energy of the airplane as it departs the runway, and the airport's layout, geography and rescue capability.

In addition, a major factor is whether the crew has flown a stabilized approach.

"Not every unstabilized approach ends up as a runway excursion, but almost every runway excursion starts as an unstabilized approach," Burin said.

Conversely, a major factor in risk reduction is a stabilized approach, with a landing in the touchdown zone, but other factors — including speed, use of brakes and reverse thrust, and runway condition — also play contributing roles.

Global Plan

For years, any discussion of runway safety has emphasized runway incursions. Many of the groups involved with the RSI already have developed products intended to prevent runway incursions; only a few existing products address runway excursions.[8] Plans call for the RSI to support and promote existing and ongoing programs by these and other organizations to prevent runway incursions while leading the effort against runway excursions.

"There is a lot of visibility, high-level attention and work on preventing runway incursions," Burin said. "Data show we are being effective in preventing runway incursion accidents, but the number of incidents and their severity still indicates a very high risk.

"There is *not* a lot of activity in the runway excursion area, and the RSI team will lead the efforts to reduce the risk in this area."

The RSI's ongoing development of its *Global Plan for the Prevention and Mitigation of Runway Excursions* is its primary effort to help all segments of the aviation industry to address the safety issues involved in runway excursions.

In recent months, three RSI committees have been drafting briefing notes that will be consolidated into the *Global Plan*. An August meeting was planned to review an early draft; the final product — consisting of 20 to 30 briefing notes

This Lion Air McDonnell Douglas MD-82 overran the runway after a flight from Jakarta, Indonesia, to Solo City in 2004, killing 25 people.

and supporting data — is expected to be completed in 2009.

Planned segments of the *Global Plan* will address runway excursion causal factors and best practices — including discussions of the contributions that constant-angle nonprecision approaches, and precision and precision-like approaches can make toward achieving stabilized approaches.

The plan will address all segments of the aviation industry, including manufacturers, which must provide reliable data and procedures for both normal and non-normal operations; operators, which must provide stabilized approach criteria and a "true no-fault go-around policy," as well as appropriate training; and pilots, who must practice good decision making during runway operations.

Other recommendations and briefing notes will be directed at airport operators, which are responsible for runway design, markings and signage, clearing and cleaning, and condition measurement; installation of runway end safety areas; approach aids; lighting; and aircraft rescue and fire fighting; and air traffic control (ATC), which must assist flight crews in their performance of stabilized approaches and provide pertinent and timely information about weather and runway conditions.

In some cases, programs have been adopted that helped improve mutual understanding between pilots and air traffic controllers, Burin said, citing the joint training/discussion sessions involving US Airways pilots and controllers in Charlotte, North Carolina, U.S. The sessions, designed to increase awareness of task management, risk management, error management and team building, resulted in a significant reduction in unstabilized approaches and go-arounds.[9]

In the Netherlands, similar sessions were conducted after the fatal 1992 crash of a 747 into an apartment building in suburban Amsterdam. One phase of the program, designed to acquaint controllers with the operational requirements of pilots during unusual situations, involved flight simulator sessions in which participating controllers were assigned to act as a copilot and communicate first with a "very demanding controller with a negative and noncontributory … attitude" and later with a positive and understanding controller. One participant described the session as "an eye opener."[10]

Regulatory Role

Briefing notes also will address the responsibilities of regulatory authorities, which must provide appropriate oversight and — in countries where regulators also are responsible for approaches — increase the availability of approaches with vertical guidance.

Some regulatory authorities have recently published guidance intended to aid pilots and

Recommended Elements of a Stabilized Approach

All flights must be stabilized by 1,000 ft above airport elevation in instrument meteorological conditions (IMC) and by 500 ft above airport elevation in visual meteorological conditions (VMC). An approach is stabilized when all of the following criteria are met:

1. The aircraft is on the correct flight path;
2. Only small changes in heading/pitch are required to maintain the correct flight path;
3. The aircraft speed is not more than V_{REF} + 20 kt indicated airspeed and not less than V_{REF};
4. The aircraft is in the correct landing configuration;
5. Sink rate is no greater than 1,000 fpm; if an approach requires a sink rate greater than 1,000 fpm, a special briefing should be conducted;
6. Power setting is appropriate for the aircraft configuration and is not below the minimum power for approach as defined by the aircraft operating manual;
7. All briefings and checklists have been conducted;
8. Specific types of approaches are stabilized if they also fulfill the following: Instrument landing system (ILS) approaches must be flown within one dot of the glideslope and localizer; a Category II or Category III ILS approach must be flown within the expanded localizer band; during a circling approach, wings should be level on final when the aircraft reaches 300 ft above airport elevation; and,
9. Unique approach procedures or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

An approach that becomes unstabilized below 1,000 ft above airport elevation in IMC or below 500 ft above airport elevation in VMC requires an immediate go-around.

Source: Flight Safety Foundation Approach-and-Landing Accident Reduction (ALAR) Task Force operators of turbine airplanes in avoiding runway excursions during the landing phase of flight. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 91-79, *Runway Overrun Prevention*, also offers operators information to be used in developing standard operating procedures (SOPs) to mitigate the risks of runway excursions.[11]

The AC cites data from the FAA and the NTSB showing that, in the United States, runway excursions during landing account for about 10 incidents and accidents — many of which are fatal — every year.

"These events continue to occur despite efforts by the FAA and industry to ensure that operators develop SOPs and that flight crewmembers are properly trained and operate in accordance with the SOPs," the FAA said.

"Focused training and testing of crewmembers, along with practical planning tools, are the keys to avoiding runway overrun events. This emphasis on training and checking should be targeted at initial pilot certification, as well as recurrent training and checking events. The training and checking should not be merely academic in nature. These events should emphasize real world aeronautical decision making and use scenario-based presentations in order to increase pilot recognition of high risk landing operations.

"Proper identification of the risks will help pilots employ mitigation strategies or eliminate certain risks prior to the landing event."

Included among the FAA guidance material is a "rule of thumb" table for calculating landing distances and a caution that an unstabilized approach is an unpredictable approach.

In a related action, the FAA has established an aviation rule making committee (ARC) to review regulations that affect the certification and operation of aircraft and airports for takeoff and landing on runways contaminated by snow, slush, ice or standing water.[12]

Among the ARC's responsibilities are providing recommendations on establishing landing distance assessment requirements, including safety margins, and establishing standards for runway surface condition reporting.

Unstabilized Approaches

Another regulator — the French Directorate General of Civil Aviation (DGAC) Department of Safety Management (DSM) — has published related guidance material. Because many runway excursion accidents have been associated with unstabilized approaches, the DSM developed an action plan aimed at preventing such approaches. The plan includes training reference sheets based on information from the French Air Accident Investigation Board (BEA) and a "good practice guide" for flight crews and air traffic controllers.[13]

DSM research, including a survey of 20 French airlines and a review of data from flight data monitoring systems, found that about 3 percent of approaches flown nationally were unstabilized, with "big differences between aircraft types."

The national action plan developed from DSM research emphasizes that a go-around should be the response to an unstabilized approach and that a new type of callout should be introduced during approach, when an airplane has descended to the minimum stabilization height.

"We must … continue to put out the message that an unstabilized approach is a risk and that carrying out a go-around is always a good decision in case of an unstabilized approach," the action plan says.

"Therefore, we propose that airlines standardize their callouts at the minimum stabilization height (1,000 ft, in general) on this format: At the minimum stabilization height, call out 'x ft stabilized' and if the aircraft is not stabilized, call out 'go around.'"

Other elements of the action plan include a call for airline crews to practice missed approaches beginning at minimum stabilization height rather than minimum descent altitude or decision height and for increased emphasis on training for unstabilized approach awareness. In addition, during go-arounds, air traffic controllers should avoid issuing altitude clearances, which increase pilot workload, the action plan says.

Other recommendations for ATC include improving controller awareness of the risks associated with their actions during approach and improving training on unstabilized approaches.

"Pilot-controller interactions are a contributory factor to unstabilized approaches," the action plan says. "Controllers have been censured following [accidents associated with unstabilized approaches] and overall, the pilot-controller interface is often fundamental in the genesis of unstabilized approaches.

"Good knowledge by the controller of the potential consequences of clearances or information he provides during the approach is a key factor in the campaign against unstabilized approaches."

The action plan also calls on airlines to define the operational parameters under which a visual approach is acceptable and prescribes that line training include the conduct of visual approaches. At night, instrument approach procedures should be favored, the action plan says, noting accidents in which nighttime visual approach procedures have led to unstabilized approaches and crashes.

No one was injured when this Atlas Blue 737-400 overran the runway at Deauville, France, in January.

Stephan Pichard/Airliners.net

"Given the inherent risks in these types of approaches, especially at night, it would be desirable to discourage operators from using these procedures except when an [instrument flight rules] arrival is not possible and under certain other specifically defined conditions," the plan said.

ALAR Briefing

The *Global Plan* follows the publication in 2000 of the Flight Safety Foundation *Approach-and-Landing Accident Reduction (ALAR) Tool Kit*, which includes briefing notes that discuss runway excursions and stabilized approaches (see "Recommended Elements of a Stabilized Approach," p. 15). At the time of publication, data showed that runway excursions were involved in 20 percent of the 76 approach-and-landing accidents and serious incidents that occurred worldwide from 1984 through 1997.[14]

In those crashes — and in others since then — excursions typically occurred because of some combination of weather factors, crew technique/decision factors and systems factors.

The briefing note said that runway excursions could be categorized according to their primary causal factor into one of six "families of events": events resulting from unstabilized approaches, incorrect flare technique, unanticipated or "more-severe-than-expected" adverse weather conditions, reduced braking or loss of braking, an abnormal configuration — perhaps caused by an aircraft being dispatched under MEL conditions or by an in-flight malfunction — and incorrect crew action and coordination under adverse conditions.

Recommended accident-prevention strategies called for:

- "Adherence to standard operating procedures;
- "Enhanced awareness of environmental factors;
- "Enhanced understanding of aircraft performance and handling techniques; and,
- "Enhanced alertness for flight-parameter monitoring, deviation calls and crew cross-check."

Eight years after production of the *ALAR Tool Kit*, runway safety issues persist. The goal of the RSI is to reiterate the runway safety message that was one of the themes of the ALAR project and find new ways to specifically address the risks of runway excursion accidents.

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Indispensable **Upgrades**

BY DON BATEMAN

Only the latest TAWS software and databases, plus GPS positioning, can optimize terrain/obstacle warnings with hardly any unwanted alerts.

I applaud U.S. airlines, their pilots, the U.S. Federal Aviation Administration (FAA) and the MITRE Corp. for working in concert toward the use of data from flight operational quality assurance (FOQA) programs with other sources to improve the safety of all who travel by air (*ASW*, 5/08, p. 25). Real world operational data, including the knowledge gained from accidents, help improve not only the design but the performance of flight safety equipment and operations. However, I have some concerns.

The industry needs to be careful about how we use digital flight data recorders while examining complex issues such as unwanted alerts from a terrain awareness and warning system (TAWS) because the parameters recorded often lack the necessary detail about critically important factors. This can end up distorting and hurting a well-intentioned study. Further, we need to wisely invest precious public funds by using the work that others in the industry already have accomplished.

As described in the May 2008 *AeroSafety World,* the limited method used in the FAA-industry study of unwanted TAWS alerts was not a wise choice. A key variable, the technical characteristics of each TAWS unit, was mentioned but apparently not considered. As a result, the flight data from FOQA programs provided no information about a TAWS unit's manufacturer, model, software version, database version or whether the aircraft position data sent to the unit was from a flight management system (FMS) or a global positioning system (GPS) receiver/sensor.

This omission is significant. Ongoing research on the Honeywell enhanced ground-proximity warning system (EGPWS) shows that a large number of unwanted alerts are caused by the failure of many operators to periodically update the software. The updates improve the alerting algorithms and expand the database of terrain, obstacles and airports. Many airlines have never updated their EGPWS database since they installed or received the equipment.

Similarly, unwanted alerts also can be traced to a failure to use GPS to provide a direct source of aircraft three-dimensional (3D) position to the EGPWS — latitude, longitude and geometric altitude. In aircraft equipped as recommended, however, unwanted alerts from the EGPWS unit have been reduced to less than one per 20,000 flights (*ASW,* 6/08, p. 21). The remaining unwanted alerts have been caused mostly by some characteristics of unstabilized approaches that should not cause a TAWS alert.

Despite the widely hailed adoption of this technology, an aircraft equipped with EGPWS or other TAWS equipment still could experience a controlled flight into terrain (CFIT) accident because of the factors involved in unwanted TAWS alerts. In such a CFIT scenario, the impaired TAWS equipment would not provide a timely warning to the flight crew (Figure 1, p. 20). In one serious incident in 2006, the EGPWS-equipped aircraft struck power lines some 1,200 m (3,937 ft) short of the runway. There was *no* EGPWS warning because the unit's software had not been updated and there was no GPS data direct to the EGPWS. With the latest software and GPS data direct to EGPWS, that flight crew would have had more than 30 seconds of warning prior to colliding with the power lines.

Such scenarios underscore the importance of updating the database at least once a year to help provide timely alerts and reduce the probability of an unwanted warning. Keeping the system fully operational requires sound avionics maintenance practices. It is also important for operators to provide a standard operating procedure in which one terrain display is enabled on every departure or arrival to enhance pilot situational awareness of terrain and obstacles.

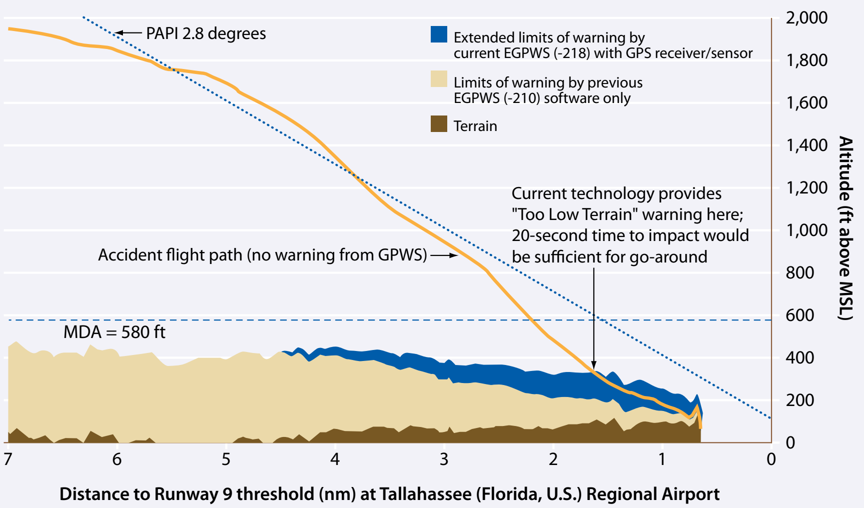
An EGPWS unit that uses only the FMS and barometric altimeter as its data sources for aircraft position can have limitations such as map shift, faulty updating of aircraft position while navigating to ground coordinates; a mismatch between the geographic coordinates issued in a nation's aeronautical information publication and the World Geodetic System 1984 reference frame (WGS-84) coordinates used by TAWS for terrain, obstacles and runway-end positions; and altimetry errors.

When an EGPWS-equipped aircraft has the latest software and terrain-obstacle-airport database installed — and also uses GPS as an aircraft position source — current research shows that it will have virtually no unwanted TAWS alerts in the United States and will be compatible with most air traffic control (ATC) vectoring.

A GPS receiver/sensor, with geometric altitude enabled in the EGPWS example, is especially important because it provides earlier terrain/obstacle warnings when needed near the runway, creates less risk of unwanted alerts, provides compatibility with QFE operations[1] and provides independence from barometric altimeter-setting errors and altimeter errors. Unfortunately, more than half of the 18,000 large commercial jet aircraft currently equipped with EGPWS operate without the benefits of aircraft 3D position from GPS direct to EGPWS.

When updated as recommended, EGPWS and other TAWS units also may add proprietary functions that help reduce the risk of loss of control, a premature descent or a collision with an obstacle during a go-around. The "peaks" function of EGPWS, for example, helps the pilot to detect a possible premature ATC descent clearance over mountainous terrain and provides a descent aid during an off-course weather deviation or a descent required by engine shutdown or an explosive decompression of the cabin. This can be enabled on any EGPWS unit by changing a jumper wire on the unit to enable display of the highest terrain value ahead of the aircraft, display obstacles and provide aural and visual warnings for a possible flight path into a tower or obstacle higher than 30 m (98 ft) above terrain. An estimated 60 percent of airliners equipped with EGPWS do not have these functions enabled.

Go-Around Opportunity With Current TAWS Technology



EGPWS = Honeywell enhanced ground-proximity warning system; GPS = global positioning system; GPWS = ground-proximity warning system; MDA = minimum descent altitude (unused nonprecision radar approach); MSL = mean sea level; PAPI = precision approach path indicator; TAWS = terrain awareness and warning system

Note: Federal Express Flight 1478, a Boeing 727, struck trees on short final approach and crashed short of Runway 9 on July 26, 2002. During this night visual approach to landing, the crew did not respond to the too-low indication of the PAPI. The onboard GPWS, which met existing requirements, was not designed to provide terrain alerts in this landing scenario. EGPWS also does not provide terrain alerts in this scenario unless the software and terrain-obstacles-airport database are current and the unit receives aircraft latitude, longitude and geometric altitude from a GPS receiver or internal GPS sensor.

Source: Don Bateman and U.S. National Transportation Safety Board

Figure 1

Various methods of identifying sources of unwanted TAWS alerts have evolved. As an analytical tool, a nonvolatile flash-memory device was designed into EGPWS units in 1995 to automatically store flight path data whenever a terrain caution or warning alert occurs. Conditions such as wind shear and excessive bank angle also activate recording. The memory retains a flight history from 20 seconds prior to each alert to 10 seconds after the alert. An airline can download this deidentified data with a memory card for its own analysis and/or contribute the data to the Honeywell research database.

The flight history comprises the aircraft groundspeed, ground track, airspeed, heading, altitude, vertical speed, geographic position during the event, runway track and location, flap/gear configuration, EGPWS software version, EGPWS terrain/runway database version and the aircraft type. In accordance with agreements reached in 1995 with the initial airlines that installed EGPWS and their pilot associations, the flight history has no time/date stamp or aircraft registration number.

To date, more than 11 million departures — counting flight legs/sectors — have been audited from a total of some 300 million departures of Western-built large commercial jets around the world without compromising the privacy of the pilots or the airlines. Contributions of downloaded flight histories to this research database during the last 10 years have led to EGPWS software upgrades and the improvement and validation of databases. Specifically, the audits have helped validate that runway locations match their WGS-84 coordinates. They also have helped to improve algorithms in the software to increase the predictive terrain warning time in case of an inadvertent flight path into the ground or into water short of the runway.

Today, an industry goal should be to systematically prioritize all types of unwanted warnings in the cockpit, isolate the systemic causes and reduce those warnings through improvements in the total system architecture. In my opinion, the minimum operational standards for the traffic-alert and collision avoidance system (TCAS) and ATC practices need to be revisited (*ASW*, 6/08, p. 17). For example, the smart use of automatic dependent surveillance–broadcast (ADS-B), including flight path intent information from the FMS of the other aircraft to improve the integrity of TCAS could help greatly to reduce unwanted resolution advisories and help both the pilot and the air traffic controller.

Thus, if U.S. airlines, the FAA and industry partners combine forces to collect actual warning data that give sufficient detail on the equipment in use, analyzing these data will allow us all to make improvements to complete aircraft systems and the traffic environment.

Don Bateman, corporate fellow-chief engineer, flight safety technologies, at Honeywell Aerospace, received awards for research and development of EGPWS in the 1990s and GPWS in the 1970s.

Note

1. In the QFE method, the pilot adjusts the altimeter with a setting provided by the airport so that it will read zero at touchdown on the runway.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Fernando Antonio, Associated Press

MARGIN for ERROR

Enhancing overrun survivability with runway end safety areas.

BY MARK LACAGNINA

Airplanes continue to run off the ends of runways lacking adequate overrun areas with disastrous consequences, yet acceptance of a unified standard for overrun areas and installation of safety areas where they are needed generally remain slow. Civil aviation authorities worldwide appear to have given a mixed reception to recent changes in international airport design requirements intended to prevent or reduce damage and injury during overrun on takeoff or landing. Some states are proceeding with aggressive efforts to meet the new International Civil Aviation Organization (ICAO) standards for runway end safety area (RESAs) — clear and graded areas beyond the runway — while others continue to consider whether the changes are necessary and practicable.

The standards and recommended practices in ICAO Annex 14, *Aerodromes*, long have provided a safety net for airplanes that inadvertently veer off the sides or run off the ends of runways. As airplane performance and size have increased over the years, the organization has revised its standards accordingly. Until 1999, however, the only requirement was for *strips* — areas surrounding the runway and stopway, if provided, that are fairly level, clear of obstructions such as large rocks and tree stumps, and graded to eliminate mounds and depressions. Although neither required nor recommended by ICAO, stopways are provided at the ends of some runways primarily to facilitate airplane deceleration during a rejected takeoff.

Specifications for strip size vary according to runway length and, in some cases, whether the runway has an instrument approach procedure. A runway less than 800 m/2,600 ft long is designated a Code 1 runway. A Code 2 runway is from 800 m to 1,199 m. A Code 3 runway is 1,200 m/4,000 ft to 1,799 m. A Code 4 runway is at least 1,800 m/6,000 ft.

Required minimum strip lengths beyond the runway end are 60 m/200 ft for Code 2, 3 and 4 runways, and Code 1 runways with instrument approaches; and 30 m/100 ft for Code 1 runways without instrument approaches. Required minimum strip widths for runways with precision approaches are 300 m/1,000 ft for Codes 3 and 4, and 150 m/500 ft for Codes 1 and 2. These widths also are recommended for runways with nonprecision approaches. For runways without instrument approaches, the recommended strip widths are 150 m for Codes 3 and 4, 80 m/260 ft for Code 2 and 30 m for Code 1.

Beyond the Strip

Annex 14 previously had only *recommended* that a RESA at least 90 m/300 ft long and twice

David Heald, Aerosafety Systems

Five people were killed in May, when an A320 overran the short runway and tiny safety area at Tegucigalpa's Toncontín airport .

the width of the runway be provided at the end of the strips on Code 3 and 4 runways, as well as Code 1 and 2 runways with instrument approaches. That recommendation was changed to a requirement in 1999.

At the same time, ICAO established a new recommendation: Annex 14 now says that, "as far as practicable," the RESA should extend at least 240 m/800 ft from the strips on Code 3 and 4 runways, and at least 120 m/400 ft from the strips on Code 1 and 2 runways.

Some civil aviation authorities have chosen to go beyond the new Annex 14 standards. For example, the Austrian Civil Aviation Authority and the U.S. Federal Aviation Administration (FAA) require RESAs at air carrier airports to be at least 300 m long (Figure 1, p. 24). Others have established lower requirements; Japan's Civil Aviation Bureau, for example, has set the minimum length at 40 m/130 ft.

Differences filed with ICAO and current as of February 2005 indicated that several states — including Canada, France, the Netherlands and New Zealand — were reviewing their airport design standards to determine whether the RESA requirements should be adopted. Differences filed by Greece and Russia said simply that they do not require RESAs. Greece said that it provides "a graded strip beyond the runway end at all airports." Similarly, Russia said, "[RESA] functions are performed by sections of the runway strip located beyond the runway ends."

A 190-ft (58-m) engineered materials arresting system provides some protection between the end of Logan's Runway 04L and a steep drop into Boston Harbor.

Elevated Safety Area

Australia's Civil Aviation Safety Authority (CASA) told *ASW* that it has met its own May 2008 deadline for providing ICAO-standard RESAs on all air carrier runways in the country — with one exception: Runway 25 at Sydney Kingsford Smith International Airport.

Although RESAs have been provided for the other five runways at Australia's busiest international airport, Sydney's Runway 25 presents a challenge because it abuts the airport perimeter road, a major highway, the city's largest sewer conduit and a river. Undaunted, the airport operator, Sydney Airport Corp., has proposed building a RESA *above* the obstructions (Figure 2, p. 25). The elevated safety area would be supported by more than 100 concrete beams, each 27 m (89 ft) high and weighing more than 25,000 kg (55,115 lb). The estimated cost of the project is AU$85 million (US$81 million).

Pending government approval of the proposed project, construction is expected to begin in October and be completed in 2010. During construction, Runway 25 will be closed for eight months and open for restricted operations for 10 months. Runway 07 will be used only when the crosswind component on the other runways exceeds 20 kt and for urgent medical or emergency operations.

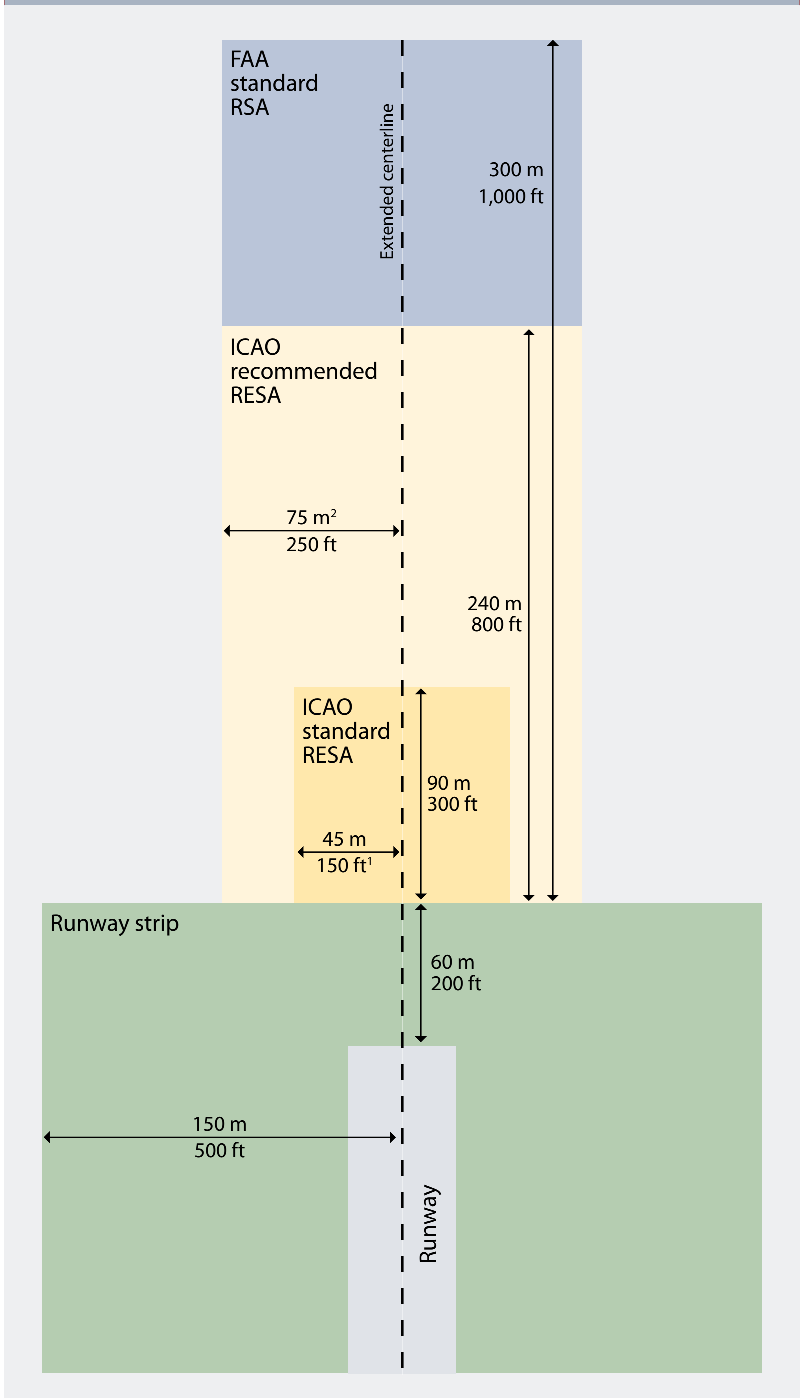
Meanwhile, Sydney Airport Corp. is providing a temporary RESA for Runway 25 by reducing available takeoff and landing distance on the 2,529-m (8,298-ft) runway by 97 m (318 ft).

Negligence?

On the other side of the world, failure to provide an adequate safety area reportedly is among the allegations of an estimated CA$180 million (US$178 million) lawsuit filed against the Greater Toronto Airports Authority, Transport Canada (TC), Nav-Canada and individual air traffic controllers.[1]

An Air France representative confirmed to *ASW* that the lawsuit was filed by the airline's

Runway Strip and Safety Area Standards



RESA = runway end safety area; RSA = runway safety area;
FAA = U.S. Federal Aviation Administration; ICAO = International Civil Aviation Organization

Notes:

1. Required width is twice the runway width.
2. Required width is equal to width of graded portion of strip.

Sources: International Civil Aviation Organization and U.S. Federal Aviation Administration

Figure 1

insurers, La Réunion Aérienne, but declined to provide details. Media reports said that the lawsuit was generated by the Aug. 2, 2005, accident at Toronto's Pearson International Airport, involving an Air France Airbus A340 that overran Runway 24L.

The final report on the accident by the Transportation Safety Board of Canada (TSB) said that the A340 touched down during a thunderstorm 3,800 ft (1,158 m) beyond the threshold of the wet 9,000-ft (2,743-m) runway, ran off the end at 80 kt, crossed two roads and came to a stop in a ravine.[2] Twelve of the 309 occupants were seriously injured during the crash and evacuation. The airplane was destroyed by the impact and post-crash fire.

The report noted that the strip beyond Runway 24L, which was constructed in 2002, met Canadian airport-design requirements defined in Technical Publication (TP) 312E. The strip consisted of a 100-ft (30-m) asphalt blast pad and a 100-ft grassy area beyond the end of the runway. TP 312E does not require airports to meet ICAO's safety area standards. "However, TC is presently reviewing the Canadian airport certification requirements, including consideration to harmonize with the current ICAO requirement of a RESA," the TSB report said. "It is estimated by TC that this harmonization will not take effect for a number of years."

The report also said, "Had Runway 24L been designed with a RESA built to ICAO recommended practice [i.e., 240 m long], the damage to the aircraft and injuries to the passengers may have been reduced."

The lawsuit by Air France's insurers reportedly alleges that TC was negligent in failing to implement recommendations generated by a coroner's inquest into a previous accident at Pearson: the June 26, 1978, overrun by an Air Canada McDonnell Douglas DC-9.

The final report on the 1978 accident by TSB's predecessor, the TC Aviation Safety Bureau, said that the DC-9 pilots felt vibrations and heard a thumping sound during takeoff from Runway 23L (which has since been designated as Runway 24R).[3] The right engine then began to lose power, and the first officer called out an indication that the right main landing gear was unsafe. Airspeed was 149 kt — 5 kt below V_1 — when the captain took the first action to reject the takeoff. He reduced thrust to idle and then deployed the spoilers, applied the wheel brakes and told the first officer to apply reverse thrust.

However, only partial wheel braking initially was applied, the report said; maximum braking was not applied until nine seconds after the throttles were closed. "If the captain had applied maximum braking as he retarded the throttles … the aircraft would have stopped with at least 480 ft [146 m] of runway remaining," the report said.

The DC-9 overran the runway at 70 kt. "It traversed 457 ft [139 m] of overrun and went over a 51-ft [16-m] precipice at about 46 kt," the report said. "It came to rest at the bottom of a ravine." Of the 107 people aboard the airplane, 51 passengers were killed, and 43 passengers and four crewmembers were seriously injured.

Investigators determined that the tread on the right main gear inboard tire had separated and debris had entered the engine and struck and damaged the gear down-and-locked switch. The DC-9 was near maximum takeoff weight, and the 9,500-ft (2,896-m) runway was reported by other pilots as "neither dry nor wet, but 'moist,'" the report said. "The accelerate/stop distance for this flight under the prevailing circumstances was 9,410 ft [2,868 m]."

The inquest by the Ontario coroner's office resulted in several recommendations, including that "an extended runway safety area of 1,000 ft be created for Runway 23L [at Pearson] by constructing a causeway across the ravine" and that the grassy area between the runway and the ravine be paved "to provide better braking for aircraft." Neither recommendation was accepted, according to TSB.

Not Enough

Although it regularly applauds the implementation of RESAs, the International Federation of Air Line Pilots' Associations (IFALPA) also maintains that the ICAO-required 90 m is not enough. The federation has encouraged airport operators to provide the recommended 240 m.

About one quarter of air transport accidents and incidents involve aircraft that overrun or veer off the sides of runways, according to IFALPA. "These events occur, on average, at a rate of about one a week. Most of these instances lead to little more than minor damage to the aircraft with few, if any, injuries to passengers and crew. However, when these events happen at airports with an insufficient area in the runway overrun, the risk of major injuries and death for passengers, crews, airport staff and passers-by is dramatically increased."

IFALPA recently pointed to the Taca Airlines A320 crash at Tegucigalpa, Honduras, on May 30 as an example. Preliminary reports indicate that the flight crew conducted a missed approach to Runway 02 at Toncontín International Airport and then landed with a slight tailwind on Runway 20, which has an available landing distance of 5,414 ft (1,650 m). The A320 overran the damp runway, went down a steep embankment and came to a stop on a road. Two

Sydney's Plan

SWSOOS = sewer conduit

Source: Sydney Airport Corp.

Figure 2

"When these events happen at airports with an insufficient area in the runway overrun, the risk of major injuries and death is dramatically increased."

passengers, the captain and two people in vehicles on the road were killed.

Noting in a June 5 press release that the safety area off Runway 20 is only about 15 m/50 ft long, IFALPA said that the Taca accident was "yet another demonstration of the unacceptable threat to passengers and crews posed by inadequate RESAs."

Legislative Push

The FAA has targeted 1,020 runways at 570 U.S. commercial service airports under a program designed to ensure that they meet "runway safety area (RSA)" requirements based on a study showing that 90 percent of the airplanes involved in overruns from 1975 to 1987 came to a stop within 1,000 ft of the end of the runway.

The agency requires that RSAs, "to the extent practicable," extend no less than 1,000 ft beyond the end of runways used by airplanes with approach speeds greater than 120 kt. The minimum standards are lower for runways served by airplanes with lower approach speeds; the shortest specified RSA length is 250 ft/75 m.

In November 2005, the U.S. Congress enacted legislation requiring owners and operators of commercial service airports to meet the RSA standards by the end of 2015. In a February progress report, the FAA said that "all practicable RSA improvements" had been completed at 345 commercial service airports. "The number of runways with an RSA complying with 100 percent of the standard increased from 30 percent in 2000 to 56 percent by 2008," the agency said. "RSAs substantially meeting standards, defined as dimensions that are within 90 percent of the standard, have increased from 55 percent in 2000 to 74 percent in 2008."

The FAA said that its goal is substantial compliance with the RSA standards at 87 percent of the runways by the end of 2015 and noted that US$1 billion has been allocated by Congress to complete the program.

Alternatives, Bad and Good

Annex 14 concedes that terrain and structures beyond the departure ends of some runways will be "particularly prohibitive" to the implementation of standard RESAs. The recommended alternative is to reduce the "declared distance" — that is, the published takeoff and/or landing distance available on the runway.

That is an option of last resort for several civil aviation organizations. The FAA, for example, says that its policy "does not allow reducing runway length or the use of declared distances if there would be an operational impact on the aircraft currently using the airport."

An option that has been embraced by the United States, as well as China, Spain, the United Kingdom and other nations, is the engineered materials arresting system (EMAS), a bed of cellular concrete that crushes under the weight of an overrunning airplane, absorbing energy and slowing the airplane or bringing it to a stop (*ASW*, 8/06, p. 13). Under the FAA standards, an EMAS is equivalent to a 1,000-ft RSA if it is capable of stopping the "critical aircraft" — generally, the heaviest airplane that is operated on the runway at least 500 times a year — after it overruns the runway at 70 kt.[4] Another alternative allowed by the FAA, if a standard RSA or EMAS cannot be installed, is a nonstandard EMAS, which can stop the critical airplane after it overruns at 40 kt.

As of October 2007, 29 EMAS arrestor beds had been installed at 22 airports worldwide and had been credited with five overrun "saves" in the United States, alone.

No Panacea

RESAs and EMAS arrestor beds have the potential to soften the outcome of overruns, but they will not replace government/industry efforts to reduce causal factors such as unstabilized approaches, faulty landing performance calculations, misuse of airplane systems and inadequate runway-condition reports.

"Experts we surveyed said that runway overruns are caused by factors such as pilot misjudgments about speed, altitude or distance; inadequate information on weather and runway conditions; and aircraft equipment failure," said the U.S. Government Accountability Office in a recent report on the FAA's progress.[5]

In addition to RESAs and EMAS, "preventive measures, such as training to improve pilot skills, also are needed," the report said.

Notes

1. Campton-Smith, Bruce. "Air France Sues Over Crash." *The Toronto Star*. June 4, 2008.
2. TSB Aviation Investigation Report A05H0002.
3. TC Aviation Safety Bureau report no. A78H8002.
4. Heald, David J. "Runway End Safety Areas and Engineered Materials Arresting Systems." Paper presented at the Flight Safety Foundation 60th annual International Air Safety Seminar, Seoul, Korea, Oct. 1–4, 2007.
5. GAO report no. 08-29, *Aviation Runway and Ramp Safety*. November 2007.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BY HANS HOUTMAN

Never Cross RED

Exceptions to a global rule weaken the effectiveness of the stop bar as a last defense against runway incursions.

Hindsight is always an advantage in assessing how an airport surface movement guidance and control system (SMGCS) can be improved. The object is not to dwell on the past but to start an informed discussion about more effectively preventing runway incursions. A current case in point is the stop bar, a deceptively simple safety concept. We all believe in the power of a red traffic light when driving to work. Red is red, and we stop.

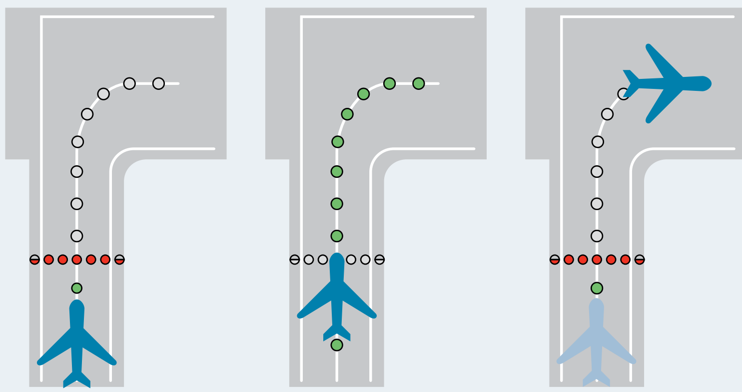
The International Civil Aviation Organization (ICAO) in 1958 began to publish guidance on the use of the stop bar. A stop bar is one row of flush-mounted unidirectional red lights installed across a taxiway with 3-m (10-ft) spacing to designate a runway-holding position or intersection/taxiway-holding position. It is operated by air traffic services and, when lighted, shows where air traffic control (ATC) requires that aircraft and vehicles stop.

ICAO specifications also call for green taxiway centerline lead-on lights to be extinguished for at least 90 m (295 ft) beyond a lighted stop bar, commonly called a "red" stop bar (Figure 1, p. 28). When ATC issues a clearance to proceed, the controller turns off the red lights and the section of interlocked lead-on lights illuminates showing the taxi route to the runway. After an aircraft/vehicle crosses the stop bar, all lights are reset manually or automatically.

Investigations of European runway incursions suggest that a few safety issues involving stop bar implementations and human errors need a fresh look:

- Controllers in some states routinely instruct pilots and others to cross red stop bars; in other states, pilots are prohibited from crossing a red stop bar even if cleared by ATC to proceed beyond the stop bar. Elsewhere, pilots are permitted to cross a red stop bar with ATC clearance if ATC provides an escort vehicle and/or the

Simple Sequence in Stop Bar Concept



Stop bar lights on
Lead-on lights off

Aircraft stops and holds

Stop bar lights off
Lead-on lights on

Aircraft proceeds

Stop bar lights on
Lead-on lights off

Next aircraft
stops and holds

Note: Operated by air traffic control, stop bars are one element of an airport surface movement guidance and control system also used by vehicles.

Source: International Civil Aviation Organization

Figure 1

clearance explicitly notes that crossing the red stop bar is a one-time exception to the rule because of a stop bar failure;

- In some runway incursions, ATC has directed pilots' attention to traffic on or in the vicinity of the runway while issuing a conditional taxi clearance, which allows the cleared aircraft to taxi only after another action, such as passage of another aircraft, has occurred. During this distraction, pilots forgot or otherwise failed to comply with the red stop bar; and,
- In other runway incursions, pilots failed to see a red stop bar because the cut-off viewing angle of the cockpit obstructed their forward view.

Civil aviation authorities typically report the crossing of a red stop bar as a runway incursion because an ATC clearance to proceed is not sufficient: according to ICAO Annex 2, *Rules of the Air,* a pilot needs an ATC clearance *and* the red lights have to be extinguished.[1,2] Preventing the crossing of a red stop bar has proven difficult.

Preventing the crossing of a red stop bar has proven difficult.

Safety professionals therefore should heed the lessons of history, such as the records from 1964 to 1980 of the ICAO Visual Aids Panel (VAP) and runway-incursion investigations in this decade.[3]

In 1964, early stop bars were used in conjunction with centerline lighting control. They primarily obviated the need for radio communication of some ATC taxi instructions; they also could be used to regulate the flow of traffic entering a runway or through a taxiway intersection. In 1970, ICAO standards required that markings for a runway-holding position near a Category II instrument landing system (ILS) be provided wherever necessary to hold aircraft or vehicles farther from the runway to avoid interference with radio navigation aids. One of the exceptions was that stop bars fulfilled the requirement for marking this position if under the control of air traffic services.

In 1972, use of the stop bar increased to supplement/replace markings when appropriate for poor visibility conditions. The VAP discussed numerous instances in which pilots were unaware of the guidance available from visual aids. Researchers also were experimenting with a variation: Elevated lights called "wing bars" were added on the sides of the taxiway to provide deceleration guidance to aircraft approaching the stop bar, and to enable pilots to identify more accurately their position in relation to the stop bar. In 1976, signs were recommended to make a runway-holding position with a stop bar more conspicuous.

In 1978, the cockpit cut-off viewing angles of some types of aircraft were found to influence pilot compliance. Some pilots could not see the stop bar when the aircraft was near it — about 23 m (75 ft) in the case of the Boeing 747, for example — so the aircraft could not be slowed sufficiently to stop where required. Some of those aircraft encroached on another taxiway or runway. The VAP aimed to make the stop bar more visible and, if possible, to develop alternate procedures. Elevated red lights at each end of a stop bar also proved necessary at some runway-holding positions, irrespective of the aircraft type, if the stop bar might be obscured by snow or rain. The VAP also decided that pairs of these elevated lights should be provided, in case one should fail, and that each side of the taxiway should have a pair so that the pilot, the copilot or both could see the signal.

In 1980, the VAP wanted failure of all stop bar lights to be preventable by design of the electrical circuits. Some members of the VAP pointed out that the existing stop bar concept could be unsatisfactory in low-visibility conditions. This revived discussion of whether the "go" signal would be made more effective by illuminating a row of green lights. Proponents of green lights said that under conditions of poor visibility or power failure, a pilot could misinterpret the disappearance of the red lights as the go signal. They said green lights would be a safer, more positive go signal. They argued that tests had shown that red for stop/green for go was useful and did not increase controller workload.

Proponents of keeping the existing red-only method argued that experience with the stop bar was still limited, so it would be premature to consider adding green lights; that the existing stop bar concept had not been proven inadequate/unsafe; and that green lights likely would introduce problems such as increased controller workload.

In a 1980 meeting, the VAP heard that traffic in one state was required by ATC instructions to cross the red stop bar. The air traffic services provider argued that it was safer to leave the stop bar lighted at all times because busy controllers might forget to manually turn on the stop bar for the next aircraft or vehicle. In another state, controllers reportedly did not want to operate the stop bars that had been installed, so the red filters covering lights were changed to yellow.

The VAP's response was unanimous: Keeping stop bars continuously red and routinely instructing traffic to cross a red bar is detrimental to safety. Such practices, even in one state, weaken the entire concept. The signal could have only one meaning: Do not cross a red stop bar. Amendments during the next 28 years refined the basic concept. In the early 1980s, for example, airports began following ICAO's recommendation to add yellow, alternately illuminated taxi-holding position lights on each side of a stop bar. In 2002, the VAP recommended broader implementation of stop bars as a runway-incursion countermeasure.

In summary, use of stop bars in a nonstandard manner could lead to confusion and possibly to accidents. Flight crews might be operating in an airport-ATC environment with the strict rule not to cross any red stop bar, even if ATC clears the aircraft to line up on the runway. An hour and a half later, the same flight crew might be operating on an airport where they are required by controllers to cross a red stop bar.

ATC in all states should adhere to ICAO standards and recommended practices for stop bars. Pilots use more than one airport. Pilots may operate in more than one country. It is in everyone's interest to use just one method: Red is red, so we stop.

Hans Houtman is coordinator-investigator, Incident Investigation, ATC The Netherlands.

Notes

1. The equipment and required/recommended applications are described in Annex 14, Volume I, *Aerodrome Design and Operations,* section 5.3.19, "Stop Bars," and in paragraph 9.8.6.

2. Annex 2, paragraph 3.2.2.7.3 contains related procedures for controllers, pilots and drivers, including, "An aircraft taxiing on the maneuvering area shall stop and hold at all lighted stop bars and may proceed further when the lights are switched off."

3. One example cited in European runway-safety presentations is one of two airproxes on Nov. 23, 2002, at Zurich Airport. The Federal Aircraft Accident Board of Switzerland said that the crew of an Air France Boeing 737 crossed both a red stop bar and Runway 24 during the takeoff by a Swiss Saab 2000 on the same runway, and the Saab overflew the 737 at a height of 40 to 50 m (131 to 164 ft). The board cited in part the 737 crew's "lack of concentration during a taxiing procedure" and failure "to monitor their taxiing route continuously." The position of the sun behind the 737 was noted. Safety recommendations included high-priority implementation of a subsystem in an advanced SMGCS to provide visual and audible alerts of stop bar violations on air traffic controller workstation displays.

Going Public Again

Most countries opt for a one-page chart to release their results in the current cycle of ICAO safety-oversight audits.

BY WAYNE ROSENKRANS

Credible information about what national governments do — and fail to do — to keep airline travel safe has become easier to find since the International Civil Aviation Organization (ICAO) launched its Flight Safety Information Exchange (FSIX) Web site <www.icao.int/fsix> two years ago. As of mid-2008, all member states have consented to post on this site their results from the current six-year cycle of audits, 2005–2010, under the ICAO Universal Safety Oversight Audit Program (USOAP).

This public disclosure is required by a joint declaration by these states, but the results posted may consist of a one-page *level of implementation chart* or a comprehensive *final report,* each state deciding what it will post. Which level of disclosure predominates — and how effectively the information disclosed achieves the original goals of public transparency and accountability — remain open questions.

Every civil aviation authority audited by the USOAP receives an unabridged confidential audit final report that authorized officials of other states can obtain from secure pages of FSIX. Member states also have secure access to confidential contents of ICAO's Audit Findings and Differences Database. Any report published in public areas of FSIX is an abridged version of the confidential audit final report.

Anyone who has Internet access can download current-cycle results for 28 of the 190 ICAO member states. Of these 28 states, 14 (Table 1) have posted the final report along with the chart. Posting of a 15th final report and chart — for Mali — was pending in July. The other 14 states of the 28 have posted only the chart.

A list on FSIX showed that 47 more states have consented to post only the chart when it becomes available. ICAO has not yet released details of what FSIX will post for the remaining 114 member states of ICAO. By comparison, from the initial audit cycle of USOAP — that is, audit visits in 1999–2001 and follow-up audit missions in 2001–2004 — a total of 162 states gave consent to post 75 full audit summary reports and 87 executive summaries, ICAO said.

Roberto Kobeh González, president of the ICAO Council, said, "The fact that … states have authorized ICAO to go public means that they recognize the critical safety benefit of transparency. I commend all member states for embracing such transparency in sharing audit results among themselves through the ICAO Web site. I also encourage them to provide their consent for posting audit results under the comprehensive [systems] approach as soon as they become available. This will further enhance aviation safety around the world and promote greater understanding by the public about a critical aspect of civil aviation."

FSIX also has evolved into a source of facts and opinions about

ICAO USOAP Final Reports on Public Web Site

Member State	Report Date	Previous Audit Cycle Posting
Belgium	November 2006	ESFR
Bulgaria	March 2007	ES
Canada	January 2006	ESFR
Czech Republic	September 2006	ESFR
Ethiopia	October 2007	ESFR
Ghana	August 2007	ES
Indonesia	November 2007	None
Italy	March 2007	ESFR
Jordan	September 2007	None
New Zealand	November 2006	ESFR
Norway	February 2007	ES
South Africa	July 2007	ESFR
Sudan	August 2007	None
Trinidad and Tobago	November 2007	None

ES = pre-2004 executive summary of results; ESFR = pre-2004 executive summary and full report of results; ICAO = International Civil Aviation Organization; USOAP = Universal Safety Oversight Audit Program

Note: Final reports from these audits, conducted in the 2005–2010 audit cycle using ICAO's comprehensive systems approach, were downloadable from <www.icao.int/fsix> as of July 15, 2008. Another public area of this Web site contains results from the 1999–2004 audit cycle for 162 states.

Source: ICAO Flight Safety Information Exchange

Table 1

the performance of ICAO itself through state comments within final reports and comments posted separately by states. The site recently added a new table of information about the safety actions recommended to ICAO by individual states, the origin of these recommendations and how ICAO has responded (Table 2, p. 33).

The site is one of the products of March 2006 decisions by the world's directors general of civil aviation, who endorsed the *Global Aviation Safety Roadmap* and agreed to raise public awareness of deficiencies, corrective actions and financial/political costs (*ASW*, 1/07, p. 28). The motivation was, and is, to accelerate compliance by national governments with the eight critical elements of safety oversight[1] as expressed in the USOAP. The strategy treats the citizens of all states as valued stakeholders who have a legitimate interest in improving commercial air transport safety (*ASW*, 2/07, p. 39).

The two-tiered approach to disclosing results on FSIX reflects different points of view expressed by directors general in 2006 — and the compromise they reached. States do not explain their choice on FSIX, and the compromise does not restrict them from providing copies of a final report on their own Web site or otherwise if they wish.

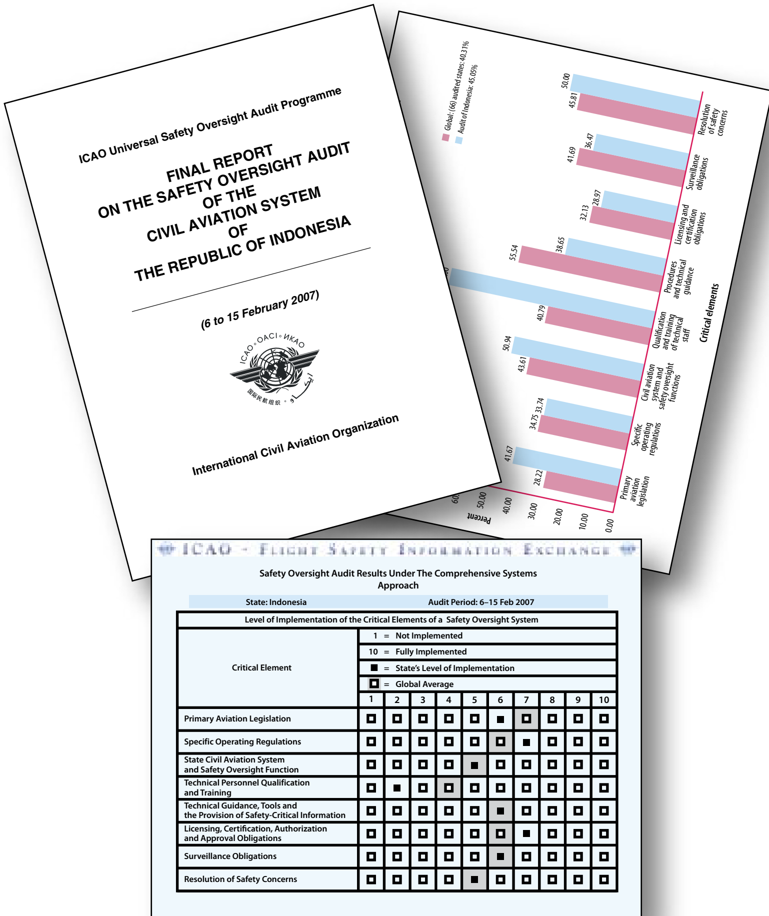
Full-Disclosure States

Among the 14 states that posted a final report, the reports range from 79 to 272 pages and average 152 pages.

States that have consented to post only a chart from the current cycle, and have done so, are Cameroon, Democratic Republic of the Congo, Egypt, Fiji, Gambia, Greece, India, Israel, Malaysia, Panama, Seychelles, Sierra Leone, Thailand and Vanuatu. This compares with decisions by Cameroon, Gambia and Greece to post a full audit summary report in the previous audit cycle; the other initial-audit states in this group posted an executive summary and/or a one-page graph, or they did not consent to the posting of any results.

States that said they would post only the chart from the current cycle, but have not yet done so, are Angola, Argentina, Armenia, Australia, Austria, Bolivia, Chile, Comoros, Congo, Côte d'Ivoire, Cuba, Democratic People's Republic of Korea, Denmark, Djibouti, Dominican Republic, France, Guinea-Bissau, Honduras, Hungary, Jamaica, Kazakhstan, Kenya, Madagascar, Malawi, Mauritania, Nauru, Netherlands, Nicaragua, Philippines, Poland, Republic of Korea, San Marino, Slovakia, Sweden, Syrian Arab Republic, Tajikistan, Tanzania, Turkey, Turkmenistan, Uganda, Ukraine, United Kingdom, Uruguay, Uzbekistan, Venezuela, Vietnam and Zambia.

This compares with decisions by Armenia, Australia, Chile, Denmark, Dominican Republic, France, Guinea, Honduras, Hungary, Netherlands, Poland, Slovakia, Sweden, Tanzania, Turkmenistan and the United Kingdom to post a full audit summary report in the previous audit cycle; the other states in this group posted an executive summary and/or their graph, or they did not consent to the posting of any results.



The FSIX posting for Indonesia includes both its 272-page final report and its level of implementation chart.

Value of a Final Report

A final report provides significantly more information than a level of implementation chart. Each final report also incorporates a *lack of effective implementation chart* — a more precise and detailed presentation of state versus global performance on critical elements of a safety oversight system. Review of the final reports already posted shows that they provide insights into the auditing process and expectations of the international aviation community; the performance of ICAO auditors; the extent to which auditors' findings are accepted or rejected by the state; the effects on safety oversight of inadequate financial, technical and human resources; the difficulty of changing practices that vary from global standards; and ICAO's challenges in following up on corrective actions by states.

In contrast, a level of implementation chart provides only a whole-number scale from 1 (not implemented) to 10 (fully implemented) of black squares showing the auditors' ranking of state implementation of each element; gray squares showing the global average level of implementation; whether the audited state's performance generally is better, worse or equal to the global average; and the audit period. The chart included in a final report notably adds a comparison of the exact percentage lack of effective implementation in global audits and in the audited state; the total number of audited states at the time; and one overall audit result for the state and the world, respectively, also expressed as a percentage.

Common Challenges

Review of the first 14 final reports posted on FSIX shows that some audit findings — or related issues — appear repeatedly among these states, as noted below for the states in parentheses (*ASW*, 8/07, p. 30). These paraphrased examples of findings suggest that posting a final report not only fulfills a state's public disclosure commitment but also promotes international public understanding of the underlying challenges of global standardization in air transport oversight.

A policy existed to notify ICAO of a state's regulatory differences from standards and recommended practices (SARPs) but the state had no procedure or systematic review to identify differences (Belgium, Bulgaria, Canada, Indonesia, Italy, New Zealand and Sudan). ICAO was not informed properly about accidents and incidents as required, related procedures were inadequate or incorrect data formats were sent to ICAO (Belgium, Canada, Czech Republic, Norway and Trinidad and Tobago).

Parliamentary review of, interference with or resistance to amendments to civil aviation regulations slowed or deterred state compliance with changes in SARPs, or the state said that regulations would not comply with SARPs because the state exceeded requirements of SARPs in an alternate manner (Czech Republic, Ghana and New Zealand). State regulations allowed

Continued on page 35

ICAO Responses to Safety Recommendations by Member States

Issue	State and Context	ICAO Response
Airworthiness. Develop standards for the classification and format of service information issued by aircraft, engine and component manufacturers, including a robust global system of distributing service bulletins. Develop standards for states to ensure appropriate performance measures for continuing airworthiness.	**Australia** said that uncertainty about continuing airworthiness regulatory requirements, reliance on operator expertise and reliance on actions of regulators in other states led to missed metal-fatigue inspections of airliners in 2000–2001 and other breakdowns in safety oversight.	The Airworthiness Panel of the Air Navigation Commission determined that the global standards of continuing airworthiness as requested were unfeasible. ICAO said that in 2004, amendments to Annex 8, *Airworthiness of Aircraft,* adequately addressed the need for consistent practices.
Defibrillators. Develop global standards and recommended practices (SARPs) requiring the carriage of automated external defibrillators (AEDs) by all airliners in international commercial air transport and related crew training.	**Belgium** said that a Boeing 737 captain in September 2002 became incapacitated by cardiac arrest after takeoff with no AED aboard the airplane; the unconscious captain occupied the left cockpit seat until after landing.	Analysis of the issue by ICAO is ongoing. Data show AED use has been indicated for about 44 in-flight cardiac arrests per year and, with global AED carriage, could save about 224 lives in 10 years.
State Responsibility. Distinctions between scheduled flights and charter flights affect state oversight, responsibility to ensure operators' regulatory compliance and technical support from ICAO and other states.	**Benin** and the **BEA of France** said that the December 2003 fatal crash of an overloaded 727 during takeoff raised questions about whether ICAO had adequately educated leaders of states about their safety oversight responsibilities.	ICAO said that the proliferation of different types of commercial aviation operations has challenged many states, and that its strategic-level efforts and publications in 2005 and 2006 have addressed these issues.
Takeoff Safety. ICAO and other authorities should develop a requirement for a takeoff performance monitoring system that would provide an accurate and timely warning of inadequate takeoff performance.	**Canada** said that the fatal takeoff overrun accident of a 747 in October 2004 raised the issue of a crew being unaware that performance is less than required until it is too late to reject the takeoff.	ICAO said that the proposed system would have to use mature technology and be proved effective before any change to SARPs, and that ICAO could participate in studying systems developed by others.
ACAS Response. Pilots must be educated and trained to respond correctly to an ACAS resolution advisory (RA) and to have confidence in the system. Investigators of ACAS incidents would benefit from relevant data recordings and from audio recordings capturing the sound in workspace of air traffic controllers.	**Germany** said that the July 2002 midair collision of a 757 and a Tupolev TU154 in part involved inadequate standards from ICAO for the standardization of national ACAS regulations, operations and procedural instructions by manufacturers and operators. ICAO should ensure globally consistent RA responses.	ICAO said that various documents concerning ACAS, including standards for operations manuals and training, have been "clarified and strengthened" but implementation depends on states and industry even with the USOAP. ICAO relayed recommendations to the Air Navigation Commission for consideration, noting potential methods of recording ACAS data.
Audit Follow-Up and CVRs. ICAO should conduct in-depth tracking of corrective action taken in response to its audit findings, applying pressure on states if required for timely implementation of action plans. Requirements for CVRs and DFDRs also should be upgraded.	**Greece** said, following a fatal accident in August 2005 involving in-flight cabin depressurization of a 737, that action was needed on recommendations that ICAO require audio recordings of company communications, that CVRs that can record an entire flight be considered and that cabin altitude be recorded on the DFDR. The **United Kingdom** separately called for installing advanced CVRs on all public transport category aircraft, including helicopters, and promoting the development of lightweight CVRs and DFDRs after a Hughes 369 accident in July 2003.	ICAO said that the comprehensive systems approach for USOAP as of 2005 addressed the issues of corrective action plans and target dates with ICAO follow-up procedures, and Web site availability of USOAP results to all states. ICAO said that CVRs already record company aural communications, but that the Flight Recorder Panel began to consider the other changes in 2007.
Runway Friction. International requirements for runway friction measurement should be reassessed in light of the latest research on determining friction characteristics of contaminated runways.	**Iceland** said that in December 2003, a 737 stopped beyond the landing distance available for a runway and that differences between braking conditions reported and those experienced were a factor.	ICAO plans to address the recommendation "in due time" considering that the Aerodromes Panel of the Air Navigation Commission in December 2006 also has recommended work on the measurement and reporting of runway surface friction characteristics.
Audit Results. Different policies on treatment of European operators create uncertainty and confusion for the public when an operator from one state is found by another state to have safety deficiencies. The state of registration may not enforce minimum requirements.	**The Netherlands** said, following a McDonnell Douglas MD-88 runway-overrun in June 2003 after a rejected takeoff beyond V_1, that ICAO should verify how audit results on the quality of a state's safety oversight can be made available to the public under the USOAP.	ICAO said that since March 2006, states have been encouraged to disclose to the public their USOAP audit results, and ICAO has "developed an ongoing process to allow the release of relevant information to the public."

Table 2

(continued next page)

ICAO Responses to Safety Recommendations by Member States

Issue	State and Context	ICAO Response
Helicopter Work. Absence of ICAO standards leaves all decisions about regulating aerial work operations to individual states and so is detrimental to safety.	**Oman** said, after a May 2005 landing accident in which the main rotor blades of a Bell 212 struck a 25-m (82-ft) ground antenna mast, that states are unable to base their helicopter regulations on international standards because of the current ICAO policy.	ICAO annexes omit any requirements for helicopters engaged in aerial work primarily because of the diversity of work, intentionally leaving any operational restrictions to the discretion of states. ICAO said that compliance with locally developed, state-supervised operating procedures is sufficient to prevent such accidents.
Circling Category. International standards do not require formal notification to ATC of a widebody aircraft's approach category or circling minimum. The controller typically has to ask the pilot directly, which may cause higher workload, misunderstanding and error.	The **Republic of Korea,** citing the April 2002 crash of a Boeing 767 during a circling approach, recommended that a standard be developed to add an aircraft approach category column to ICAO's standard flight plans to record the category and circling minimum of the specific aircraft for ATC.	The Air Traffic Management Section of the Air Navigation Bureau declined to pursue this change. ICAO said that it would not benefit ATC, which cannot require flight crew compliance with approach and landing minimums and does not accept primary responsibility for terrain clearance during a circling approach.
Water Drainage. International standards of runway construction should be reviewed to ensure adequate drainage of heavy rain, and research should be encouraged to measure braking action on runways under all conditions of surface contamination.	**Singapore** said, in the context of a December 2002 runway overrun by a DC-8 during heavy rain and a January 2004 runway excursion by a 777 during rain, that better test equipment should be produced to measure wet runway characteristics.	ICAO agreed to consider amending relevant annexes to provide for small stepdowns from runway surface to shoulder and from shoulder to grass as a possible means of improving drainage at airports affected frequently by heavy rain.
Improvised Approaches. The accident report of a controlled flight into terrain involving failure to use the current published instrument procedures should be disseminated.	**Timor-Leste** said, after an Ilyushin 76 crashed in January 2003 on approach, that lessons from this fatal accident should be applied worldwide.	ICAO summarized the accident in the *ICAO Journal* and has made a digital copy of the complete report available on <www.icao.int>.
Cockpit Image Recorder. Accident investigators wanted but were unable to determine how propellers were selected by a pilot during flight from flight control range to ground control range.	**United Arab Emirates,** citing the fatal crash of a Fokker 50 during approach in February 2004, recommended the use of a crash-protected cockpit image recorder to help answer questions about which pilot handled the propeller controls. The **United Kingdom** issued a similar recommendation in the wake of a major electrical failure incident in October 2005 on an Airbus A319 in which the primary flight displays and navigation displays went blank for 90 seconds.	ICAO said that the global standards for cockpit image recorders have been an ongoing work project of the Flight Recorder Panel.
Blast Pad Debris. Damage was caused to an airliner's tailplane and elevator when takeoff thrust lifted and broke up a blast pad at the runway threshold.	The **United Kingdom**, citing undetected damage from blast pad debris to a 737 prior to takeoff in July 2005, recommended standardized markings and pad and pavement designs resistant to damage from engine inlet suction/jet blast.	ICAO referred the issues to the Aerodromes Panel for further study. ICAO has been consulting states on a November 2007 proposal that called for blast pad inspections and monitoring to reduce risk of debris and loose objects.
Accident Investigation. First responders and investigators need protection from hazardous goods and other risks at aircraft accident sites based on correct information about cargo.	The **United Kingdom,** citing the crash of a 747 in December 1999, urged adequate support of the work of the ICAO Hazards at Accident Sites Group and consideration of new technology for tracking cargo to assist accident investigations.	ICAO in 2007 issued guidance for working safely at accident sites, and said that its Dangerous Goods Panel in 2004 had amended relevant guidance and forwarded the dangerous goods tracking concept for further discussion by an appropriate working group.
Runway Distance Markers. Benefits to runway situational awareness and disadvantages should be considered as a first step toward installing distance markers when the runway profile prevents a flight crew from having a continuous view of the end of the paved surface.	The **United Kingdom,** citing a May 2005 incident involving the flight crew's emergency steering of an A320 to prevent a landing overrun, recommended consideration of this visual aid for runways with unusual profiles.	ICAO said that the Air Navigation Commission would study the issues and develop new runway specifications, if necessary, as amendments to Annex 14, *Aerodromes.*

ACAS = airborne collision avoidance system; ATC = air traffic control; BEA = Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile; CVR = cockpit voice recorder; DFDR = digital flight data recorder; ICAO = International Civil Aviation Organization; USOAP = Universal Safety Oversight Audit Program

Note: Australia's recommendation about ballistic parachutes for light general aviation aircraft are excluded. The United Kingdom's recommendations for handling airport magnetic anomalies (*ASW,* 05/08, p. 18) are excluded.

Source: ICAO Flight Safety Information Exchange

Table 2

exemptions to ICAO flight operations or airport requirements but states had no criteria to conduct risk assessments, grant exemptions, require risk mitigations or monitor the resulting level of safety (Bulgaria, Jordan and South Africa).

Human resources management or staffing levels of government agencies or departments were insufficient to provide effective safety oversight, typically because of financial constraints, personnel retirements and high rates of employee turnover or difficulty competing with private companies to pay staff in critical areas (Belgium, Bulgaria, Indonesia, Italy, Norway, South Africa and Sudan). The state did not have an adequate method to determine whether the quantity and quality of technical staff and inspectors were sufficient for the level of air transport activity or to safely adjust to budget cuts (Czech Republic, Ethiopia, Ghana, Indonesia, Italy, New Zealand, Norway, South Africa, Sudan and Trinidad and Tobago).

No program or an inadequate program existed for safety oversight, quality control and/or safety inspections of airports, air navigation service providers and other third-party providers of aeronautical products, procedures and services (Bulgaria, Ethiopia and Sudan). States did not retain final safety oversight responsibility as required when delegating work to regional organizations such as the European Aviation Safety Agency, privatized air navigation service providers and privatized airport operators (Czech Republic, Italy and Trinidad and Tobago).

Safety management systems for airports and air traffic services, airport certification procedures, runway safety programs and/or associated risk assessment and auditing techniques were not implemented or not implemented effectively, or corrective action was not taken in response to airport inspections (Bulgaria, Indonesia, Jordan, New Zealand, Sudan and Trinidad and Tobago). Runway end safety areas at airports were not compliant with state regulations or SARPs so formal risk assessments and mitigating measures were recommended (Bulgaria, Indonesia, Jordan and Trinidad and Tobago). The civil aviation authority was expected to perform safety oversight of aircraft rescue and fire fighting (ARFF) services at civil airports, validating adequate training, equipment and extinguishing agents even if the military or another government ministry operates ARFF (Bulgaria, Jordan and Trinidad and Tobago).

Regulations on dangerous goods training were expected to apply to commercial air transport operators whether or not they are currently involved in the transport of dangerous goods or whether police agencies enforce these regulations (Canada, Czech Republic and Indonesia). Financial penalties for regulatory noncompliance were nonexistent or no longer high enough to have a deterrent effect, whether imposed by a civil aviation authority or a police agency (Ethiopia, Italy, Sudan and Trinidad and Tobago).

Various categories of safety inspections were conducted and documented but systems/procedures were inadequate for monitoring and tracking deficiencies and follow-up actions (Bulgaria, Ethiopia, Indonesia and Jordan). Lack of national legislation or other problems prevented the introduction of nonpunitive voluntary incident reporting systems and/or databases for them (Belgium, Czech Republic, Ethiopia, Italy, New Zealand, Norway and Trinidad and Tobago).

Independence of accident investigation authorities was compromised compared with ICAO requirements according to auditors, although some states disagreed (Ghana, Italy, South Africa, Sudan and Trinidad and Tobago). Understaffing of accident investigation authorities or inadequate systems to allocate resources prevented the timely initiation or completion of significant numbers of accident investigations (Belgium, Indonesia, Italy and Norway).

Updating of official manuals for airworthiness, flight operations, airport and/or air navigation services inspectors lagged behind organizational changes, or these types of procedures in manuals needed to be strengthened (Canada, Czech Republic, Ethiopia, Ghana, Sudan and Trinidad and Tobago). Civil aviation regulations, the state aeronautical information publication, aircraft registration certificates, aircraft operating certificates and other safety-critical documents were not available in English to foreign operators (Indonesia). An aeronautical information publication was noncompliant if it directed users to a Web site to find the state's significant differences with SARPs; they must be included in this publication (Canada and New Zealand).

Note

1. ICAO specifically audits how effectively member states provide the following critical elements of a safety-oversight system: primary aviation legislation; specific operating regulations; state civil aviation system and safety oversight functions; technical personnel qualification and training; technical guidance, tools and the provision of safety-critical information; licensing, certification, authorization and approval obligations; surveillance obligations; and resolution of safety concerns.

BY MARK LACAGNINA

Two's Too Many

Angled taxiways limiting the pilots' view of the runway, clearances issued and read back hastily and incorrectly, and crossed radio transmissions[1] were among the common factors involved in two "critical runway incursions" that occurred two months apart last year at Auckland International Airport, said the New Zealand Transport Accident Investigation Commission (TAIC).

Both incidents involved twin-turboprop regional aircraft, whose pilots took last-minute action to avoid collision, stopping their aircraft on the runway within a few meters of each other with no damage and no injuries.

The first incident occurred on May 29, 2007, in daytime visual meteorological conditions. Four employees of Airways New Zealand were on duty in the airport traffic control tower, including an aerodrome controller who was responsible for aircraft on the runway and airborne in the control zone, and a ground controller who was responsible for aircraft movements on the ramps and taxiways. Both were qualified for all tower positions.

Auckland has a single runway — Runway 05R/23L, which is 3,635 m (11,926 ft) long and 45 m (148 ft) wide. "Six of the 10 taxiways [join] the runway at an angle of 30 degrees to the runway centerline to form rapid-exit taxiways for landing aircraft," the report said. "For example, Taxiways A4 and A6 [are] rapid-exit taxiways for Runway 23L." The parallel taxiway was used temporarily as a runway during the 1990s when extensive repairs were being performed on Runway 05R/23L; although closed as a runway, the taxiway retains markings as Runway 05L/23R.

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The pilots' limited view of the runway while holding on angled taxiways at Auckland International was a factor in two critical incursion incidents.

"The [control] tower was located about 500 m [1,641 ft] north of the intersection of Runway 23L and Taxiway A5," the report said. "Controllers had an unobstructed view of all the taxiway holding points for Runway 23L/05R."

Wrong Call Sign

The events leading to the first incursion began when the ground controller cleared the flight crew of an Air Nelson Saab 340A, call sign Link 659, to taxi from the ramp via Taxiway B5 to the runway holding point on Taxiway A5 (Figure 1, p. 39). "The Saab pilots had completed their pre-takeoff checks and had changed to the aerodrome controller's radio frequency (Tower) as they approached the holding point," the report said.

The Saab captain told the aerodrome controller, "Link 659 is ready in turn Alpha 5." The aerodrome controller acknowledged the transmission. The Saab was among seven aircraft that were being handled by the aerodrome controller. A Swearingen Metro was holding for takeoff on Taxiway A1; an aircraft was departing; and four aircraft were arriving. First in sequence for arrival was an Eagle Airways Raytheon Beechcraft 1900D, call sign Eagle 766.

Another Air Nelson aircraft, a Bombardier Q300 with the call sign Link 383, was taxiing to the holding point on Taxiway A3. "The ground controller had instructed its pilots to call Tower when ready, but they had not yet changed frequency," the report said. "The instruction to call Tower meant that control of the aircraft had passed from the ground controller to the aerodrome controller. Airways [New Zealand] procedures required the ground controller to pass the flight progress strip for [Link 383] to the aerodrome controller at the same time."

Each flight progress strip contains essential information, such as aircraft type and call sign. After a controller issues a clearance to the aircraft, he or she writes the clearance and the time the clearance is issued on the strip before passing it to the next controller. "The strips for the Saab, Link 659, and the [Q300], Link 383, were correctly prepared, but the distinction between the handwritten holding points, A5 and A3 respectively, was not clear," the report said.

After clearing Eagle 766 to land on Runway 23L, the aerodrome controller and the ground controller discussed whether a departure could be conducted between the 1900's landing and the next arrival. The Metro holding on Taxiway A1 was the likely choice because the crew had announced that it was ready for takeoff before the captain of the Saab announced ready for takeoff from Taxiway A5. "It was not determined why the aerodrome controller had not already decided to depart that aircraft [the Metro] first," the report said.

The ground controller suggested that Link 659 could take off between the 1900 and the next aircraft on approach, and she pointed at

This Air Nelson Saab 340A was among seven aircraft that were being handled by the aerodrome controller when the first incident occurred.

Follash/wikimedia.org

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The second incident involved two Eagle Airways Raytheon Beechcraft 1900D flight crews who accepted a takeoff clearance meant for only one of the airplanes.

the Saab on Taxiway A5. However, the ground controller was not at her normal position in the tower; she had moved to accommodate an electrician who was working on a lighting control panel. As a result, the ground controller was standing almost behind the aerodrome controller, instead of next to her.

The aerodrome controller, who was looking in a different direction, decided to clear Link 383, the Q300 holding on Taxiway A3, for takeoff. "The aerodrome controller said that her normal practice was to read the [flight progress] strips for each aircraft that she controlled, rather than relying on memorizing call signs and types, but whether she had read the strips before issuing the clearance to Link 659 was not determined," the report said.

The aerodrome controller might have decided to clear the Q300 crew for takeoff because the airplane was still taxiing and would have been able to line up on the runway without having to stop at the holding point, the report said. "An expeditious line-up by the [Q300] would have made good use of the available gap before the next landing aircraft."

However, the aerodrome controller used the wrong call sign in the takeoff clearance. Instead of addressing Link 383, she radioed, "659, if you can take an immediate, line up Runway 23L."

The ground controller noticed that the aerodrome controller was looking at Link 383 when she issued the takeoff clearance and reminded her that Link 659 was the Saab on Taxiway A5.

The aerodrome controller attempted to amend the clearance by instructing the Saab crew to line up and wait on the runway after the landing 1900 passed by, but the radio transmission was blocked by the Saab first officer's readback of the takeoff clearance.

"The Saab captain said that he thought the aerodrome controller sounded busy and the tone of the line-up instruction meant 'don't muck around,'" the report said. "As the first officer read back the clearance, the captain looked left and saw no aircraft on the runway." He told investigators, however, that it was difficult to see the runway behind his aircraft because of the angle of the taxiway.

"Pilots seated on the left side of aircraft holding on Taxiway A3 or A5 have to look back over their shoulders through almost 150 degrees in order to see the runway threshold and can see less of the runway and approach area when holding on Taxiway A5 than when holding on Taxiway A3," the report said.

Pilots entering an active runway from an angled taxiway normally turn slightly off the taxiway centerline to improve their ability to visually check the runway and approach area. "However, if told to expect an immediate takeoff clearance, most pilots would stay on the centerline to expedite the line-up, as the *Aeronautical Information Publication* encourages," the report said. "That was what the Saab captain did, and, as a result, his look up the runway, already limited by the cockpit window design, was probably less searching than normal."

As the Saab moved toward the runway, the aerodrome controller again tried to amend the takeoff clearance, saying, "Sorry, that's behind the 1900," but the transmission was blocked by one of the Q300 pilots, who radioed, "Tower, 383 is ready A3."

"The Saab captain, after hearing '1900,' at the end of the crossed transmission, looked left again and saw the landing [1900] bearing down as it turned off the runway towards Taxiway A6," the report said. "Both aircraft were braked hard and came to a stop … about 10–15 m [33–49 ft] apart."

Similar Numbers

None of the aircraft, pilots or controllers involved in the first incident was involved in the second incident the morning of Aug. 1, 2007. Three aircraft were on the aerodrome controller's radio frequency: an aircraft on departure, another on arrival but not yet on final approach, and an Eagle Airways 1900D, call sign Eagle 979, that was holding for takeoff on Taxiway A2 (Figure 2).

The aerodrome controller told Eagle 979 to line up and wait on Runway 23L. About one minute later, the ground controller told the crew of another Eagle Airways 1900D, call sign Eagle 171, which was nearing the holding point on Taxiway A3, to switch to Tower frequency.

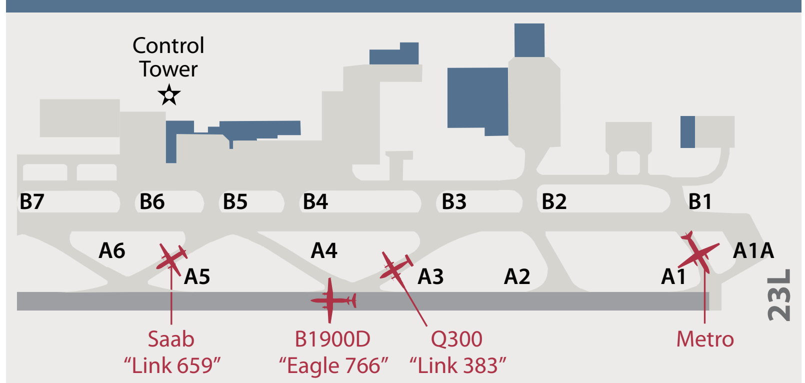
The crew of Eagle 979 held on the runway for two minutes while the aerodrome controller and the crew of the departing aircraft discussed weather conditions west of the airport. "The controller was concerned that fog was approaching the airport, and he was considering whether to implement newly introduced low-visibility procedures," the report said. Current conditions at the airport included 30 km (19 mi) visibility and a broken ceiling at 500 ft. The weather deteriorated to 3,000 m (about 1 3/4 mi) visibility and a broken ceiling at 300 ft within the next 15 minutes.

When the discussion between the aerodrome controller and the departing aircraft ended, the first officer of the 1900 holding on Taxiway A3, radioed, "Eagle 171 ready." The report said that the call sign was "clipped … and not unmistakably 'one seven one.'" The aerodrome controller heard the transmission but did not identify the call sign. "He intended to next clear the [1900] waiting on the runway, and so … he transmitted, 'Eagle 979, 23L, cleared takeoff,'" the report said.

The first officers of both Eagle 979 and Eagle 171 read back the clearance at the same time. "The aerodrome controller contributed to the holding pilots mistaking the call sign by issuing the takeoff clearance immediately after the pilots of [Eagle 171] had called ready and by not using phonetic pronunciation for the call sign numbers [of Eagle 979]," the report said. The report did not specify how the controller pronounced the call sign but said that is was not "niner seven niner" and noted that the numbers "71" and "79" are similar.

A recording of the crossed transmissions by the first officers indicated that they ended with "seven niner" and "seven one," in that order.

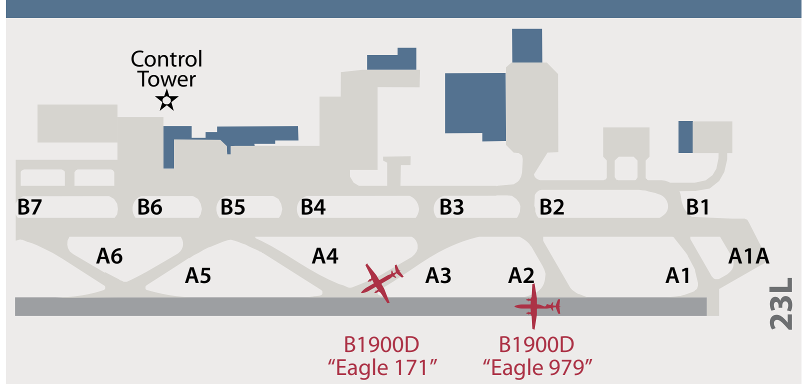
May 29, 2007



Source: New Zealand Transport Accident Investigation Commission

Figure 1

Aug. 1, 2007



Source: New Zealand Transport Accident Investigation Commission

Figure 2

"The first officer of Eagle 979 said that he heard 'seven one' after he had finished his read-back, which he thought was strange, but he did not suspect crossed transmissions," the report said. "The aerodrome controller said that he heard the crossed transmissions, but he did not associate them with either Eagle flight. He had looked away from the runway to assess the weather and then instructed the [departing] aircraft to change frequency. He did not see Eagle 979 start its takeoff or Eagle 171 move towards the runway."

The captain of Eagle 171 said that he saw only the arriving aircraft on a wide base leg when he looked back before taxiing onto the runway. Eagle 171 entered the runway about 10 seconds after Eagle 979 began its takeoff roll. The first officer of Eagle 979 saw the registration number ZK-EAH on Eagle 171's fuselage and radioed, "Eagle alpha hotel, hold. … Hold! Hold! Hold!"

"The captain of Eagle 979 had already initiated a rejected takeoff from a speed of about 60 kt," the report said. "He swerved left almost to the runway edge, while the captain of Eagle 171 veered his aircraft to the right. Each aircraft was stopped on its respective half of the runway." The wing tips were about 8 m (26 ft) apart.

Common Problems

Based on these findings, TAIC concluded that the first runway incursion "was initiated when the aerodrome controller mistook the call sign of the aircraft she intended to line up for takeoff and thereby inadvertently instructed another aircraft to line up in front of the aircraft that was landing."

The second incursion "was initiated when the pilots of the aircraft holding on a taxiway mistook the clearance for another aircraft to take off as being for them and entered the runway in front of the aircraft that was taking off."

The report said the following were among problems that not only contributed to both incidents but increase the risk of runway incursions at other airports:

- "The use of multiple runway-entry points increases the risk of runway incursions by creating more points for potential traffic conflict and a potentially higher workload for aerodrome controllers …;
- "The use of angled taxiways for runway entry increases the risk to aerodrome operations by further limiting pilots' view of the runway threshold and of other aircraft …;
- "[Pilots] do not, or cannot, check that the runway is clear before crossing the holding point …;
- "Crossed radio transmissions remain a risk to aerodrome operations …;
- "Pressure to minimize runway-occupancy times occasionally leads to hastily delivered runway line-up and takeoff clearances and too-quick compliance by pilots …; [and,]
- "The practice of not transferring control of aircraft from the ground controller to the aerodrome controller until they are near the runway holding point reduces the situational awareness of controllers, as less time is available to review aircraft details, and of pilots, because they have less time to listen on the Tower frequency before entering the runway."

Among actions taken after the two incidents was a revision by Airways New Zealand of its traffic management plan for Auckland, requiring that departures from Runway 23L be conducted only from Taxiways A1A, A1 or A2. The runway-entry point for A1A and A1 is at the approach threshold, and A2 is angled toward the approach end of the runway.[2]

In addition, the layout of the flight progress board in the Auckland control tower and procedures for placing flight progress strips on the board were revised. The board has separate bays for the takeoff-holding points, and ground controllers are required to place strips in the bays corresponding to the assigned holding points. The revision is a temporary measure, pending implementation of an electronic flight progress strip system that "should give all aerodrome controllers earlier advice of impending departures," the report said.

This article is based on TAIC Aviation Occurrence Report 07-005.

Notes

1. The TAIC report said that a *crossed transmission* — also called a blocked transmission — occurs "when two stations transmit at once [and] neither can hear the overlapped transmission but other stations on the frequency hear either a largely unintelligible 'hash' or the higher-powered transmitter." Controllers or pilots who detect a crossed transmission commonly radio "two at once" or "blocked" to alert others on the frequency.
2. The report noted that the International Civil Aviation Organization's *Manual on the Prevention of Runway Incursions* (Doc 9870) recommends that "when using multiple or intersection departures, do not use oblique or angled taxiways that limit the ability of the flight crew to see the landing runway threshold or final approach area."

Language Barrier

BY LINDA WERFELMAN

After a simple error wiped out much of their navigation information, the Polish pilots of a 737 were unable to adequately communicate their problem to British controllers.

In an incident described as typical of the risks of not speaking the same language, the crew of a Lot Polish Airlines Boeing 737-500 struggled to communicate with British air traffic controllers after their electronic flight displays went blank in instrument meteorological conditions (IMC) following departure from London Heathrow Airport.

No one was injured and the airplane was not damaged in the late morning incident on June 4, 2007, which involved a circuitous 27-minute return flight to Heathrow, where the airplane was landed safely, a report by the U.K. Air Accidents Investigation Branch (AAIB) said (Figure 1, **p. 42**). While the commander worked to resolve the problem, the copilot flew the airplane by reference to the standby instruments; the autopilots were not available, although the autothrottle system was used.

At one point in the flight, as the airplane was flown north instead of north-northeast as directed, it came into conflict with another aircraft, whose crew was issued revised instructions to maintain separation, said the report.

During the flight, there were "a number of exchanges between [the pilots] and the controller in which it was apparent that the commander, who was making the radio calls, was not able to understand some of the instructions," the report said.

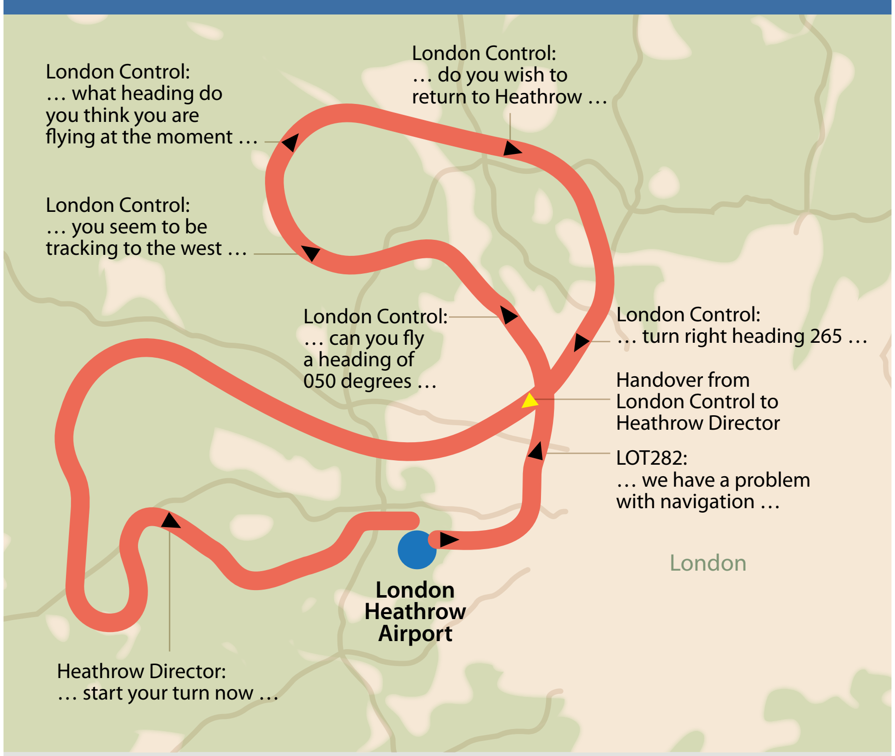
At one point, the controller observed, "Lot 282 you appear to be tracking to the west now," and the commander responded, "Turning r-er right on er west Lot er turning left on west."

Later, after another controller issued a clearance to land on Runway 09L, the air traffic control (ATC) ground supervisor became concerned that the airplane's flight path indicated that the crew might be planning to land on Runway 09R and asked that all traffic be cleared from the runway; the airplane subsequently was landed on 09L and taxied to a parking stand.

The report said that the commander, who had been flying the aircraft type for Lot for 15 years, and the copilot, who had been flying the type for six years, "appeared confused by what had occurred" with the airplane's instruments. In events such as this one, "ATC may not be able to rely upon pilots for information about the aircraft's status and their ability to fly the aircraft accurately, with degraded instrumentation," the report said.

Because pilots of aircraft with electronic flight instrument systems do not usually fly their aircraft using only basic instruments, when they are suddenly faced with such a situation, "pilots will need time to adapt their instrument scan and a higher level of crew coordination to enable them to conduct a safe instrument approach," the report said.

Radar Track of Lot 737



Source: U.K. Air Accidents Investigation Branch

Figure 1

The commander's workload was heavy, and he was under stress in this situation, contributing to his difficulties understanding ATC; the crew was "not able to communicate adequately the nature and extent of their problem," the report said.

"Although much of the difficulty in R/T [radiotelephony] communication may be explained by the added workload and stress on the pilots, this incident shows the problems that can arise when there is a lack of understanding between controllers and flight crews. The introduction of language proficiency standards should ensure that all operational personnel are qualified to a minimum and competent standard required for the task being undertaken."

Proficiency standards developed by the International Civil Aviation Organization (ICAO) call for pilots on international routes, air traffic controllers and aeronautical station operators to speak and understand English at an "operational" level and give them until March 2011 to achieve that goal (*ASW*, 11/07, p. 25). The initial deadline for demonstrating operational proficiency in English was March 2008, but, after many ICAO member states had difficulty with that timetable, the ICAO Assembly modified its requirements, generally extending the deadline until 2011.

'Plain Language' Proficiency

Elizabeth Mathews, a specialist in applied linguistics and the leader of the international group that developed the ICAO requirements, said that the Heathrow incident "highlights a number of important aspects of the ICAO language proficiency requirements," including the need for aviation personnel to be fluent in not only "aviation operational–related" English but also "plain language."

"The need for plain language proficiency can arise quickly," whenever an unusual situation develops, she said.

This incident also is a prime example of why ICAO decided to develop language proficiency requirements, said Rick Valdes, a captain for United Airlines who represented the International Federation of Air Line Pilots' Associations on the ICAO group that developed the requirements.

The pilots of the incident airplane "had their hands full" flying the airplane in IMC with only standby instruments; communicating in English with ATC was an added burden, Valdes said.

"All the holes in the Swiss cheese were beginning to line up," he said, referring to psychologist James Reason's "unsafe acts model," in which Reason likens the accumulation of difficulties preceding an incident or accident to the line-up of holes in several slices of Swiss cheese.

Valdes said that similar incidents, in which pilots and controllers struggle to communicate in non-routine situations, probably are occurring every day somewhere in the world. This incident drew more attention than most because it occurred at Heathrow, with its heavy volume of traffic, he said.

Mathews agreed that incidents like this one — in which language is not a cause of the incident but a factor in its safe resolution — are likely to draw more attention in the future, as the public and the news media become more aware of ICAO's language proficiency standards.

She said that the incident also reinforces her belief that "you can't hide inadequate English language proficiency.

"It doesn't matter what test is used, or how easy or how difficult it seems to be to pass. At the end of the day, pilots have to communicate in international settings with controllers. Perhaps a good command of phraseology will suffice most of the time. But when phraseology isn't adequate to manage the communicative needs of a given situation, inadequate plain language proficiency shouldn't prevent otherwise competent and professional pilots and controllers from resolving the issue safely."

As a result of its internal investigation of the incident, the air traffic service provider incorporated the circumstances of the incident into its training programs. The operator was considering two actions: issuing a reminder to its pilots to exercise extra caution when manually entering into the flight management system (FMS) the longitude coordinates for locations near the prime meridian, and revising its pilot training with an emphasis on the benefits of declaring an emergency in situations like this one.

'Simple Error'

The investigation relied primarily on recorded data and reports from the two pilots, and the report said that, in some respects, information from the two sources was inconsistent. The investigation found "no technical cause for the loss of the navigational data," the report said.

Nevertheless, the report added, the Heathrow incident occurred because of a "fairly simple error" during preflight preparations, as the pilots performed a "fast realignment" of their two inertial reference systems (IRSs); the procedure required the entry of their ground location. Using the FMS, the copilot entered the wrong longitudinal coordinates for the airplane's ground location. The mistake involved "the use of 'E' instead of 'W,'" the report said.

"The airports around London, because of their proximity to the prime meridian, can lead flight crews to make … coordinate-entry errors of this nature. … The operator's route network is such that there are few destinations to the west of the prime meridian and hence the majority of longitude coordinates that need to be entered would be 'eastings.' Because the geographic error was less than 1 degree, the only alert apparent to the crew would have been a 'VERIFY POSITION' scratchpad message."

The copilot did not recall seeing such a message, and the report said that, if the message appeared, it might have been "dismissed as an automated response, without consideration of the reason for the message."

Because the IRSs — which provide attitude, heading, acceleration, vertical speed, groundspeed, track, present position and wind data to the aircraft systems and were the sole source of attitude and heading information on the incident airplane, except for the standby instruments — were not initialized with the correct ground location information, they could not function in the navigation mode, the report said.

"Better cross-checking procedures, either when initially entering data or by conducting a check of the entered route against that displayed on the map, would have prevented the situation from developing," the report said. "This incident demonstrates how reliant pilots may become upon the FMS and how essential it is to ensure that the system is provided with accurate data."

This article is based on U.K. AAIB incident report EW/C2007/0602, published in the AAIB Bulletin: 6/2008.

Volpe Center, U.S. Department of Transportation

GROUND

BY RICK DARBY

Technically sophisticated driver training simulators are upgrading

Imagine that you are a newly hired driver in an airport ground crew. You are operating a tow vehicle, busily engaged at rush hour in pushing back aircraft from the gate and towing others. As you shift from one job to another in response to radioed instructions, making a sharp turn, your windshield is suddenly filling up with a moving airplane, which will soon be occupying the same space that you are heading toward.

Fortunately, your inexperience will not put you, your vehicle or the airplane at risk, because the view through your windshield — although it is a close representation of the ramp area where you will be operating and the aircraft you will be sharing it with — is a simulation.

Simulators in which new hire ground vehicle drivers are trained, and experienced drivers receive recurrent training to keep their reflexes sharp, are one of the industry's answers to the problem of accidents involving ground vehicles.

Based on activity data developed by the International Air Transport Association, the Flight Safety Foundation Ground Accident Prevention program estimates that 27,000 ramp accidents and incidents — one per 1,000 departures — occur worldwide every year. "About 243,000 people are injured each year in these accidents and incidents; the injury rate is 9 per 1,000 departures," the Foundation says. Although not all of these accidents and injuries involve ground vehicles, many do.[1]

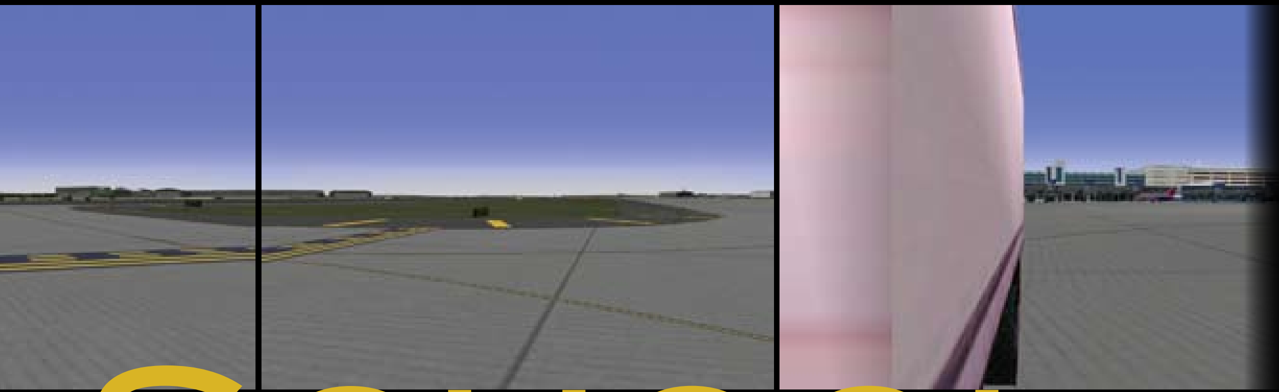
Norman Hogwood, co-director of Auckland, New Zealand–based Airside SimuDrive, the manufacturer of a simulator used by Air New Zealand, said, "Training for ground staff done the old fashioned way — that is, classroom, chalk-and-talk, and in the field with a buddy — means bad practices are copied, leading to staff injuries and aircraft damage."

David Bouwkamp, executive director business development for Arotech's FAAC Inc., which has been awarded a contract for a custom driver training simulator at Baltimore/Washington International Thurgood Marshall Airport (BWI), said that "ground time for training is vanishing, so simulation training is more important than ever before. With today's security concerns, the FAA [U.S. Federal Aviation Administration] has virtually eliminated this option for off-hours training; thus, simulation training has become critical."

The advantage of the driver training simulator is that it "provides a virtual environment where an individual can make mistakes without consequences," said Steve Heim, chief of the Department of Public Safety, Metropolitan Nashville (Tennessee, U.S.) Airport Authority (MNAA). "Mistakes made while driving on the actual airfield can have catastrophic results. The simulator also allows the drivers to become more confident and familiar with the airfield environment, and once a certain confidence level is reached, actual airfield driving begins."

"The simulator offers the 'teaching manager' complete versatility in deciding how he or she is going to conduct the training — by self-teaching sessions, or with instructor guidance supplemented by blackboard explanations, as a re-validation session, and so on," Hogwood said. "The immersive nature of the simulator ensures that students enjoy the experience and therefore more readily absorb the skills. And one of the main purposes of the simulator is to provide a more common standard of training for the myriad ramp driving tasks."

Adacel, based in Orlando, Florida, U.S., said that its Flightline Driving Simulator trains airport personnel to "operate in airport movement areas in changing environmental conditions; safely interact with moving and stationary aircraft; develop and maintain



Forward view (center) and rear views (left and right) in the cab of a driver training simulator.

SCHOOL

the skills of ground vehicle operators, with a payoff in safety.

situational awareness; understand and comply with airport signs and markings; learn airport-specific standard operating procedures; understand which movements and maneuvers require clearance, coordination and/or approval; coordinate with other ground vehicles and aircraft; [and] coordinate with [control tower] and ramp control personnel."

Pushback/tow vehicles are not the only devices for which initial and recurrent training can be conducted. Depending on the model and software ordered, one simulator might also serve as an avatar for baggage, aircraft rescue and fire fighting (ARFF), fueling, and catering vehicles. FAAC's multi-purpose simulator for BWI offers selectable functions, including towing, emergency response and even snow removal.

No overall figures are available on the numbers of driver training simulators in service, but their use appears to be growing. In 2007, Dallas/Fort Worth (Texas, U.S.) International Airport took delivery of eight new ground vehicle simulators.[2] gForce Technologies, which introduced deicing truck simulators in 2006, has added a pushback simulator that is in service with Northwest Airlines at Detroit Metropolitan Wayne County Airport.

"The more realistic the simulator, the better the suspension of disbelief," said Bouwkamp. "An accurate cab setting with physical controls, a realistic visual database including a visual replication of the airport, force-feedback steering and a 6-degree-of-freedom motion base are used in FAAC's airport driving simulator. The student feels the bumps and jars of pushing snow, running over an object, or leaving the runway and going onto unpaved terrain."

Even "desktop" simulators are sophisticated in their ability to replicate the real-world user experience through computer software. Some simulators use multiple screens to replicate forward and side vision and provide realistic sound effects, including mock radiotelephone communication. Raphael Juarez, of gForce Technologies, said, "The trainee interfaces with the 'pilot' during a 'pushback' by using a touch screen to walk through an appropriate script that each customer has requested. Although most of the verbiage is cross-company, some minor words and commands may be specific to each customer."

"The value of the simulator is in training or endorsing airside skills

rather than driver training for the vehicle," Hogwood said. "Nevertheless, a high degree of reality is achieved by the steering wheel being programmed through the use of an algorithm to calculate the necessary force feedback. The 3D [three-dimensional] sound logic parameters include distance factor, Doppler factor, rolloff factor, update frequency and a maximum of 32 channels. The sound channels are fully configurable in the lesson files, should variations be required."

Specifications for the Airside Driver Trainer, a new-product launch from Micro Nav of Bournemouth, England, are typical of driver training simulators. They include such features as "three-screen LCD [liquid crystal display] flat-panel display with high-quality images; picture-in-picture rear-view mirror; simulation of day, night, dusk, reduced visibility, adverse weather operations and emergencies; simulation of aircraft and other vehicles; [and] accurate 3D model and database of selected airports."

Simulators may or may not have a reproduction of the vehicle cab, but all have a steering wheel and brake and accelerator pedals. At the Nashville International Airport training facility, the simulator can be tweaked to change the time of day, level of sunlight, visibility distance, precipitation, surface conditions such as the degree of friction, and wind direction — the latter an important consideration for firefighters. It can also add foreign object debris.

The software can be customized to conform to the specific airport where the simulators are used, including the taxiway configuration and types of aircraft in operation there. "The simulation is virtually identical to the actual airport environment," said Heim.

Juarez emphasized that the gForce Technologies' driver training simulators are more than just fancy versions of computer games. "Computer gaming applications manufacturers typically employ one or two scientists, gaming 'content' managers and many artists," he said. "Their goal is to make applications that are fun and look good. Our work is focused on the physics behind the training applications in order to provide a truly realistic training environment and maximize what is called 'positive training transfer' and minimize 'negative training.' This can only be done by getting all the aspects of the simulated environment truly representative of the real world, such as how pushing back a narrowbody differs from pushing back a widebody. These are the math and physics that we work to get right."

The Nashville simulator, a model designated ADMS (Advanced Disaster Management Simulator)-DRIVE manufactured by Environmental Tectonics Corp. and housed in the cab of an ARFF vehicle, includes touch-screen panels that replicate vehicle-specific gauges and controls. The system is outfitted with a fully controllable high-reach extended turret and a forward-looking infrared camera, which work with the synthetic environment.[3]

At Nashville, new hires spend 16 to 24 hours in the simulator, becoming as familiar as possible with the airfield before actually operating a vehicle. Heim said, "Current Department of Public Safety officers are required to spend at least one hour per month in the simulator, for a minimum of 12 hours annually. The simulator is also used to train tenants, such as fixed-based operators and FAA staff, who operate vehicles on the ramp."

In a 2005 study, psychologists Daniel J. Hannon, Ph.D., and Stephanie G. Chase, Ph.D., of the Volpe National Transportation Systems Center of the U.S. Department of Transportation, assessed the potential for driving simulators in ground vehicle operator training.[4] They studied the use of an ADMS-DRIVE simulator in operation at the Minneapolis-St. Paul International Airport, focusing on validity — how closely the simulator resembles the real world; using simulation in training; and using simulation in recurrent training.

Their overall conclusions were that "driving simulators have potential benefits for ground vehicle operator training programs; simulators should be evaluated with respect to the training objectives; both new and experienced drivers can benefit from the use of a simulator; [and] simulators made from low-cost hardware may make them more accessible to airports around the country."

Steve Heim agrees. He said, "I cannot think of a safer and more productive way to train new people on airfield navigation and tower procedures than in the simulator. I also cannot think of a more efficient way to allow all current employees of MNAA that work in an airfield environment to maintain and sharpen their skills than in the simulator."

Notes

1. For example, see "Training Deficiency Leaves Catering Driver Unprepared to Resolve Disorientation," *Airport Operations* Volume 31 (March–April 2005), and "Tug Driver Fails to Yield Right of Way" on p. 59 of this issue of *AeroSafety World*.
2. "Runway Safety Call to Action in High Gear." *Air Safety Week*, Oct. 29, 2007.
3. For a YouTube video of an ARFF simulation using an ADMS, see <www.youtube.com/watch?v=hclY8DUuM4g>.
4. <www.faa.gov/airports_airtraffic/airports/regional_guidance/northwest_mountain/airports_news_events/annual_conference/2005/media/driving_simulator.ppt>.

MembershipUPDATE

Our sincere thanks to the organizations and individuals below for supporting the Foundation by becoming new members in 2008! The generous support of our membership enables us to help reduce risks and prevent loss of control, controlled flight into terrain, approach and landing accidents, runway incursions and other killers.

Make a commitment to aviation safety and join Flight Safety Foundation today! Contact Ann Hill, director, membership and development, at +1.703.739.6700, ext. 105, or <hill@flightsafety.org>.

Organizations

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Hantz Air

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Sharjah Civil Aviation Department

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U.S. Helicopter Fatal Accidents Decrease Again

Multi-engine turbine helicopter operations in 2007 had the best safety record.

BY RICK DARBY

Fatal accident rates in U.S. civil helicopter operations continued a five-year improvement trend in 2007, as did the rates of fatalities and serious injuries, according to data from Helicopter Association International.[1] The corresponding overall accident rate was higher than in 2006, although it remained lower than that of 2003 through 2005.

The 2007 fatal accident rate of 0.64 per 100,000 flight hours was a 16 percent decrease

U.S. Civil Helicopter Safety Trends, 2003–2007

	2007	2006	2005	2004	2003
Total number of civil helicopter accidents	178	162	193	180	214
Total number of fatal helicopter accidents	22	25	26	33	37
Total number of fatalities	43	43	44	68	67
Total number of serious injuries	35	34	44	38	51
Total number of minor injuries	55	64	74	68	83
Accidents per 100,000 flight hours	5.15	4.94	6.32	7.10	10.02
Fatal accidents per 100,000 flight hours	0.64	0.76	0.85	1.30	1.73
Fatalities per 100,000 flight hours	1.25	1.31	1.44	2.68	3.14
Serious injuries per 100,000 flight hours	1.01	1.04	1.44	1.50	2.39
Minor injuries per 100,000 flight hours	1.59	1.95	2.42	2.68	3.89

Note: U.S. National Transportation Safety Board (NTSB) preliminary accident reports include two helicopter collisions counted as one accident each. NTSB data are preliminary as of Feb. 11, 2008.

Source: Helicopter Association International

Table 1

from the 2006 rate of 0.76 and 63 percent lower than the 2003 rate of 1.73 (Table 1). The fatality rate of 1.25 per 100,000 flight hours was a 5 percent improvement on 2006's rate of 1.31. The serious injuries rate, at 1.01 per 100,000 flight hours, was 3 percent less than that of 2006 and 58 percent below the 2003 rate of 2.39.

Overall accidents rose to 5.15 per 100,000 flight hours from 4.94, a 4 percent increase, but 49 percent below the 10.02 rate in 2003.

U.S. Civil Helicopter Accident Rates, 2003–2007

	2007	2006	2005	2004	2003
Accidents per 100,000 flight hours					
Single-engine turbine	3.67	3.33	3.94	5.15	6.56
Multi-engine turbine	1.53	2.22	2.79	2.18	4.74
Reciprocating	11.72	11.26	16.86	17.70	24.77
Fatal accidents per 100,000 flight hours					
Single-engine turbine	0.66	1.42	0.82	1.19	1.34
Multi-engine turbine	0.15	0.63	0.66	0.59	1.18
Reciprocating	0.96	1.72	0.97	2.33	3.34
Fatalities per 100,000 flight hours					
Single-engine turbine	1.17	0.74	1.42	2.38	3.00
Multi-engine turbine	0.61	1.11	1.15	2.97	1.90
Reciprocating	1.91	2.91	1.46	3.31	4.69

Note: U.S. National Transportation Safety Board (NTSB) preliminary accident reports include two helicopter collisions counted as one accident each. NTSB data are preliminary as of Feb. 11, 2008.

Source: Helicopter Association International

Table 2

Rates for accidents, fatal accidents and fatalities were lowest in the multi-engine turbine category (Table 2). For all accidents, the 2007 rate of 1.53 per 100,000 flight hours for multi-engine turbine helicopters compared with 3.67 for single-engine turbine helicopters, or 58 percent lower. The rate of 11.72 for reciprocating-engine helicopters was 7.7 times higher than the multi-engine turbine rate.

The rate of fatal accidents involving multi-engine turbine helicopters was 23 percent of the single-engine rate and 16 percent of the reciprocating-engine rate. Fatalities per 100,000 flight hours increased from 0.74 in 2006 to 1.17 in 2007 for single-engine turbine helicopters, a jump of 58 percent. For multi-engine turbine helicopters, there was a corresponding drop from 1.11 to 0.61, a 45 percent improvement.

Flight instruction as a type of operation accounted for the highest percentage — 31 percent — of total U.S. civil helicopter accidents in 2007, a higher ranking than the 10-year average percentage for instructional accidents (Table 3, p. 50). Personal use operations resulted in 22 percent of accidents. Percentages of all other types of operation were in the single digits.

Canadian 2007 Accident Data

Turning to another subject, Canadian-registered aircraft were involved in 56 accidents in 2007, roughly in line with the 2003–2007 average of 57 (Table 4, p. 50), as reported by the Transportation Safety Board of Canada (TSB).[2] Three of the 2007 accidents were fatal, compared with the 2003–2007 average of five. The 17 accidents involving on-demand (air taxi) operations was 42 percent higher than the five-year average of 12.

There were five fatalities in Canadian aircraft accidents in 2007, the TSB said. That was 44 percent lower than the average of nine for the 2003–2007 period. Serious injuries in 2007 were higher than the five-year average, at 13 versus eight, respectively.

Two fewer Canadian airplanes were involved in accidents in 2007 compared with the 2003–2007 average, with an equal number of helicopters involved (Table 5, p. 51). Three aircraft were involved in fatal accidents in 2007, compared with the five-year average of four.

Rates for accidents, fatal accidents and fatalities were lowest in the multi-engine turbine category.

Type of Operation as a Percentage of Total U.S. Civil Helicopter Accidents, 1998–2007

Activity	10-Year Average	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
Total accidents	**190.8**	**178**	**162**	**193**	**180**	**214**	**205**	**182**	**206**	**197**	**191**
Instructional (FARs Part 91)	37.2 (19.6%)	55 (30.9%)	46 (23.8%)	42 (23.3%)	37 (18.0%)	43 (20.1%)	37 (18.0%)	32 (17.6%)	31 (15.0%)	22 (11.1%)	32 (16.8%)
Personal (FARs Part 91)	41.0 (21.5%)	39 (21.9%)	31 (19.0%)	46 (23.8%)	44 (24.7%)	41 (19.2%)	50 (24.4%)	39 (21.4%)	41 (19.9%)	34 (17.3%)	45 (23.6%)
Business (FARs Part 91)	10.2 (5.4%)	9 (5.1%)	13 (8.0%)	12 (6.2%)	8 (4.6%)	10 (4.7%)	11 (5.4%)	12 (6.6%)	14 (6.8%)	10 (5.1%)	3 (1.6%)
Public use (FARs Part 91)	18.0 (9.4%)	9 (5.1%)	15 (9.2%)	16 (8.3%)	14 (8.0%)	20 (9.5%)	21 (10.2%)	19 (10.4%)	26 (12.6%)	27 (13.7%)	13 (6.8%)
Positioning/ferry (FARs Part 91; excludes air medical)	10.0 (5.2%)	2 (1.1%)	11 (6.7%)	12 (6.2%)	5 (2.8%)	13 (6.1%)	10 (4.9%)	10 (5.5%)	13 (6.3%)	11 (5.6%)	13 (6.8%)
Sightseeing (FARs Part 91)	3.3 (1.7%)	2 (1.1%)	4 (2.4%)	4 (2.1%)	2 (1.1%)	3 (1.4%)	2 (1.0%)	2 (1.1%)	4 (1.9%)	4 (2.0%)	6 (3.1%)
Aerial observation (FARs Part 91)	7.1 (3.7%)	5 (2.8%)	6 (3.7%)	4 (2.1%)	9 (5.1%)	8 (3.8%)	8 (3.9%)	5 (2.7%)	7 (3.4%)	13 (6.6%)	6 (3.1%)
Executive/corporate (FARs Part 91)	0.4 (0.2%)	0 (0.6%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1.0 (0.5%)	0 (0.0%)	0 (0.0%)	1 0 (0.5%)	0 (0.0%)
Air medical service (FARs Part 91 and Part 135)	10.8 (5.7%)	11 (6.2%)	10 6.1%)	12 (6.2%)	11 (6.3%)	15 (7.1%)	11 (5.4%)	10 (5.5%)	12 (5.8%)	10 (5.1%)	6 (3.1%)
Air taxi (FARs Part 135) (Non–air medical/air tour)	11.1 (5.8%)	12 6.7%)	11 (6.7%)	7 (3.6%)	14 (7.8%)	17 (8.0%)	14 (6.8%)	11 (6.0%)	8 (3.9%)	12 (6.1%)	5 (2.6%)
Commercial air tour (FARs Part 135)	4.0 (1.9%)	4 (2.2%)	6 (3.7%)	4 (2.1%)	4 (2.3%)	5 (2.4%)	2 (1.0%)	5 (2.7%)	5 (2.4%)	3 (1.5%)	2 (1.0%)

FARs = U.S. Federal Aviation Regulations

Note: Certain activities have been excluded, so percentages in any year do not total 100.

Source: Helicopter Association International

Table 3

Accidents and Fatal Accidents, Canada, 2003–2007

	Canadian-Registered Aircraft Accidents		Fatal Accidents	
	2007	2003–2007 Average	2007	2003–2007 Average
Total aircraft involved	**56**	**57**	**3**	**5**
Airplanes involved	49	51	3	3
Airliners	2	2	0	0
Commuters	1	2	0	0
Air taxis	17	12	3	2
Aerial work	3	1	0	0
State	1	1	0	0
Corporate	0	1	0	0
Private/other	25	32	0	2
Helicopters involved	8	8	0	1
Other aircraft involved	1	1	0	0

Note: Ultralight aircraft are excluded. Some accidents may involve multiple aircraft, so the total number of aircraft involved may differ from the accident total. Five-year averages have been rounded. Figures are preliminary as of May 16, 2008.

Source: Transportation Safety Board of Canada

Table 4

"Declared emergency" topped the list of reportable incidents among all aircraft, with 118 reports, a 16 percent increase over the 2003–2007 average of 102 (Table 6, p. 51). "Other" incidents, "engine failure," "risk of collision/loss of separation" and "smoke/fire" were next in order of number of occurrences. Engine failure and smoke/fire were more frequently reported in 2007 than in the five-year average, while the number of reported collision risk incidents was 16 percent less than the average.

In terms of the numbers of Canadian-registered aircraft involved rather than the numbers of reported incidents, "risk of collision/loss of separation" ranked highest in 2007, although the number was seven fewer than the 2003–2007 average (Table 7, p. 51). "Declared emergency" was next, with 12 fewer than the five-year average. The number of aircraft

Canadian-Registered Aircraft Involved in Accidents, by Type of Operation, 2003–2007

	2007	2003–2007 Average
Accidents		
Airplanes Involved	49	51
Training	9	8
Pleasure/travel	15	23
Business	3	2
Test/demonstration/ferry	1	1
Air transport	15	13
Air ambulance	1	1
Other/unknown	5	3
Helicopters involved	8	8
Training	2	1
Pleasure/travel	1	1
Business	1	0
Test/demonstration/ferry	2	1
Air transport	0	2
Air ambulance	0	0
Other/unknown	2	3
Fatal accidents		
Airplanes and helicopters involved	3	4
Training	0	0
Pleasure/travel	0	1
Business	0	0
Test/demonstration/ferry	1	0
Air transport	1	2
Air ambulance	1	0
Other/unknown	0	0

Note: Ultralight aircraft are excluded. Some accidents may involve multiple aircraft, so the total number of aircraft involved may differ from the accident total. Five-year averages have been rounded, so total aircraft involved may not equal the sum of averages. Figures are preliminary as of May 16, 2008.

Source: Transportation Safety Board of Canada

Table 5

involved in "smoke/fire" incidents exceeded the five-year average by seven.

Notes

1. Available via the Internet at <www.rotor.com/Default.aspx?tabid=597>.
2. Transportation Safety Board of Canada. Data are available via the Internet at <www.tsb.gc.ca/en/stats/air/2008_apr/index.asp>.

Reportable Incidents, All Aircraft, Canada, 2003–2007

	2007	2003–2007 Average
Risk of collision/loss of separation	47	56
Declared emergency	118	102
Engine failure	49	45
Smoke/fire	40	36
Collision	5	7
Other	50	49
Total	**309**	**295**

Note: Five-year averages have been rounded. Figures are preliminary as of May 16, 2008.

Source: Transportation Safety Board of Canada

Table 6

Canadian-Registered Aircraft Involved in Reportable Incidents, 2003–2007

	2007	2003–2007 Average
Risk of collision/loss of separation	74	81
Air proximity	22	23
Air traffic control event	45	47
Altitude	2	3
Runway incursion	3	3
Other	2	4
Declared emergency	54	66
Landing gear failure	7	11
Hydraulic failure	12	9
Electrical failure	2	3
Other component failure	26	23
Other	7	20
Engine failure	34	34
Power loss	23	16
Component failure	10	16
Other	1	1
Smoke/fire	37	30
Fire/explosion	31	23
Component failure	5	7
Other	1	0
Difficulty in controlling aircraft	18	14
Component failure	3	6
Weather-related	10	4
Other	5	4

Note: Five-year averages have been rounded, so total incidents may not the equal sum of averages. Figures are preliminary as of May 16, 2008.

Source: Transportation Safety Board of Canada

Table 7

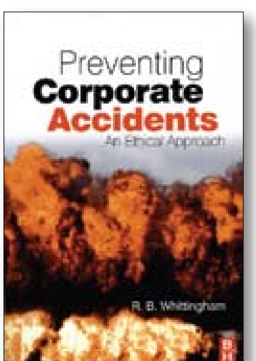
Ethics as a Safety Factor

An ethical corporate culture can balance the possible adverse safety consequences of concentrating on profit.

BOOKS

Preventing Corporate Accidents: An Ethical Approach

Whittingham, R.B. Oxford, England, and Burlington, Massachusetts, U.S.: Butterworth-Heinemann, 2008. 370 pp. Figures, tables, references, appendixes, index.



Although no one doubts that there are ethical as well as practical reasons for corporations to prevent accidents, ethical issues are probably not the first thing that comes to mind in considering what corporations can do to enhance operational safety. Whittingham's book examines corporate behavior from many angles, but its perspective is unusual in taking into account the safety consequences of the growth of "the huge international corporations which have come to dominate the world of commerce."

The separation of ownership and control, and the legal principle of limited liability, result in "a situation where any philanthropic instinct or sense of moral duty which owners might have displayed in the past has become largely subservient to the claims of profit and share price," Whittingham says.

Legally, a corporation is an artificial person. Nevertheless, Whittingham says, "the corporation has essentially no motivation to act in an ethical way outside the established legal framework, in the same way a human actor may be motivated to do." He quotes Baron Thurlow, an 18th century English jurist and lord chancellor: "Did you ever expect a corporation to have a conscience, when it has no soul to be damned and no body to be kicked?"

While no known corporation has a Department of Soul in its organization chart, a metaphorically kickable body is to be found in the corporation's vulnerability to criminal law (*ASW*, 3/08, p. 12; 5/08, p. 36). The "kickability" factor recently increased in the United Kingdom, where the Corporate Manslaughter and Corporate Homicide Act went into effect in April 2008, making an organization guilty of corporate manslaughter if someone dies because the organization's conduct "falls far below what can reasonably be expected of the organization in the circumstances."

Apart from criminal charges, corporations are subject to numerous regulations bringing the risk of fines and, perhaps more important, the "loss of corporate reputation, which can seriously damage customer confidence and sometimes threaten the very existence of the company," Whittingham says.

He suggests that, in practice, a sense of corporate ethics is the best defense against penalties arising from unsafe acts: "If the modern corporation is to limit its own exposure to risk, it needs not only to take account of its strict legal responsibilities, but also to subscribe to ethical policies which constitute a safety margin between normal and illegal operation."

Six specific systems, called "strategies," are identified as being essential to the needed standards for safety, as well as health and environmental protection. The first strategy is "safety culture," and Whittingham says that "the effectiveness of the other five strategies … is highly dependent upon the culture of the organization and whether this encourages or inhibits the day-to-day application of these strategies."

There are two basic ways to understand corporate culture, Whittingham says. The classic approach consists of factors that can be measured or observed, although some may be more subtle than others. In the Gestalt approach, "the whole is more than the sum of its parts, and to some degree the parts are determined by the whole."

The Gestalt approach "seems to suggest that an organizational culture (including a safety culture) is not something that can be developed or intentionally shaped by a company to conform to a desired pattern," Whittingham says. "Rather, it suggests that organizational culture is 'emergent'" — behavior that takes place because of individuals in the group interacting with each other independently of any plan from "above."

Either way, he says, it is doubtful that a safety culture can be generated merely through proclaimed values. "Certainly those at the top of the organization must set an example when espousing the values of the company's safety culture, but then they must ensure that the espoused values permeate through the whole enterprise and truly reflect the basic assumptions which underpin the way people behave and operate," he says. "Whereas artifacts such as safety notices and indications of safety performance, such as hours worked since a lost-time accident, are useful in promoting the idea of safety, there is little evidence that they influence employee attitudes."

To promote organizational culture change that is more than skin-deep, Whittingham proposes a three-step process:

- Create dissatisfaction with the status quo. "In order to change the culture, it is necessary for the people to change, and people will only change when they accept that change is necessary. It is always easier to carry on in the same way. The corollary of this is that it is only possible to change an organization which has accepted the disadvantages of operating the same way in the future as it does in the present."

- Create a vision. "The vision must be expressed in a qualitative way so that people not only understand it, but can become enthusiastic or even excited about it. This is why safety goals and targets are only a means to an end and not an end in themselves. However much management may like to express their achievements in terms of safety targets which have been met, and no matter how laudable, it is rare that numerical targets create great excitement among the work force. People do not get excited by visions of hours since a lost-time accident. They may, however, get excited about a vision of shared leadership in an organization in which their view and concerns about safety are taken into account."

- Create challenge but not fear. "When people are faced with the unknown they may feel inadequate to cope with the future. People who are being led through the labyrinth of change must know that they are trusted by those who are leading the change. This will help to overcome their self-doubt, enabling them to follow the vision of the future which is on offer."

Whittingham defines the strategies that flow from the safety culture as "understand the risk," "safety regulation," "safety management," "the learning organization" and "corporate social responsibility." The first three he classifies as "pragmatic" because "each is specifically directed towards a particular aspect of accident prevention rather than across all corporate

It is doubtful that a safety culture can be generated merely through proclaimed values.

activities at the same time." The next three are called "holistic" because "these strategies must be applied across every aspect of corporate life (not just accident prevention) if they are to be effective as a whole in reducing the incidence of corporate accidents. When perfectly applied, it is possible to imagine all the parts of the corporate body working effectively towards a common ethical purpose."

REPORTS

Review of the Air Traffic Controller Facility Training Program

U.S. Department of Transportation, Office of Inspector General (OIG). Report AV-2008-055. June 5, 2008. 51 pp. Figures, tables. Available via the Internet at <www.oig.dot.gov/item.jsp?id=2308>.

Developmental controllers — those who have not yet become certified professional controllers (CPCs) — made up more than 25 percent of the U.S. Federal Aviation Administration's (FAA's) national controller work force in December 2007, compared with about 15 percent in 2004, the OIG says. The report's findings are based on a review conducted between June 2007 and March 2008 of FAA air traffic control (ATC) facilities and a visit to the FAA Training Academy.

The FAA estimates that each ATC facility can conduct operations and training with a controller work force of up to 35 percent developmental controllers. It believes that any excess above that percentage will significantly increase training times, because the number of developmental controllers will surpass the training capacity.

The inspectors found confusion about who was responsible for oversight and direction of the facility training program.

"We found that many facilities meet or exceed the 35 percent level," the report says. "As of December 2007, 70 facilities nationwide (over 22 percent of all FAA ATC facilities) exceeded that level, compared to just 22 in April 2004. This represents a 218 percent increase in just three years."

The report says that many facility managers, trainers and union officials with whom inspectors spoke disagreed with the FAA's estimate of the acceptable percentage. "They stated that in order to achieve effective controller training while maintaining daily operations, the maximum percentage of developmental controllers should be limited to between 20 and 25 percent of a facility's total controller work force."

Following a controllers' strike, the FAA in 1982 and 1983 hired 8,700 new controllers, which created a large cohort of controllers who have reached or will soon reach retirement eligibility. Anticipating the need for replacing them, the FAA plans to recruit about 17,000 new controllers through 2017.

"FAA has hired 3,450 new controllers since 2005, but its hiring process is now outpacing the capabilities of many air traffic facilities to efficiently process and train new hires," the report says. "During our review, facility managers at numerous locations stated that developmental controllers assigned to their facilities had to wait for extended periods of time before starting the simulator portion of their training because the number of developmental controllers exceeded facility training capacity."

The inspectors found confusion about who was responsible for oversight and direction of the facility training program at the national level.

"Since the creation of the Air Traffic Organization (ATO), FAA has assigned national oversight responsibility for facility training to the ATO's vice president for terminal services and vice president for en route services," the report says. "In addition, the ATO's vice president for acquisition and business services oversees new controller hiring and the FAA Academy training program, and the senior vice president for finance oversees the development of the Controller Workforce Plan. All four offices play key roles in the controller training process. … During our review, facility managers, training managers and even headquarters officials were unable to tell us who or what office was ultimately responsible for facility training."

The OIG issued 12 recommendations to the FAA as a result of the review. They included the following:

- "Convene a working group that includes facility managers, training managers and union representatives to identify a target percentage or percentage range of developmental controllers that facilities … can realistically accommodate while accomplishing facility training and daily operations";

- "Establish a method for placing newly hired controllers at facilities that considers the availability of on-the-job instructors, classroom space and simulators, as well as training requirements of existing CPC staff";

- "Issue written guidance that hold managers accountable for achieving nominal 'time-to-certify' metrics for en route and terminal training programs"; and,

- "Ensure that the installation of additional simulators at terminal and en route facilities remains on schedule to capitalize on the significant success this type of training has demonstrated thus far."

The FAA fully concurred with eight of the 12 recommendations, partially concurred with two and did not concur with two.

Passenger Health — The Risk Posed by Infectious Disease in the Aircraft Cabin

Talbot, Debra; McRandle, Brendan. Australian Transport Safety Bureau (ATSB). AR-2007-050. Final report. June 10, 2008. 38 pp. Figures, references. Available via the Internet at <www.atsb.gov.au/publications/2008/AR2007050.aspx> or from ATSB.*

"The environment in aircraft cabins is receiving increasing attention as a possible problem environment with regard to air quality for both passengers and crew," the report says. "There is a perception that cabin air quality is poor on modern aircraft due to limited outside air exchange and the incorporation of air recirculation systems. Specific perceptions are that aircraft ventilation systems can cause a build-up of contaminants; spread of infectious disease; a decrease in the quantity of oxygen; and heightened carbon dioxide levels."

A moderate level of concern about cabin air quality intensified with the emergence of severe acute respiratory syndrome (SARS) in 2002 and avian influenza in Asia more recently. "Confined space, limited ventilation, prolonged exposure times and recirculating air, all common to air travel, are demonstrated risk factors for the transmission of upper respiratory tract infections in other settings," the report says. "Transmission could occur from person to adjacent person via droplets, such as from sneezing and coughing, or from person to distant person via the air recirculation system."

The report, which consists largely of a review of relevant epidemiological literature, concludes that "despite the popular view that the risk of contracting an infectious disease during air travel is high, the available evidence suggests otherwise."

Although in older airliners the flow of ventilating air was generally from the front of the cabin to the back, newer models circulate the air from the top of the cabin downward to the floor, where it is vented and either exhausted or recirculated. The ventilation system is usually designed so that air entering the cabin at a given seat row is exhausted at the same seat row, which limits the amount of air flowing through the aircraft. "Passengers at most risk of any airborne transmission of infection are those in the same or adjacent rows of seats to the infectious passenger, with minimal risk for others," the report says. "Air is also supplied and exhausted from the cabin on a continuous basis and the cabin air is completely changed every two to three minutes, which further reduces the likelihood of transmission of infection."

In addition, most aircraft with recirculation systems use high efficiency particulate air (HEPA) filters, the same filters used in hospital operating rooms. The filters remove particulates and microbial contaminants such as bacteria, fungi and some viruses from the recirculated air before mixing it with sterile fresh air to re-enter the passenger cabin. Airliners actually use a smaller proportion of recirculated air than the ventilation systems in public buildings and do a better job of filtering it, the report says.

"One study has assessed the role of air recirculation in the transmission of upper respiratory tract infections during flight," the report says. "In this study, the rate of respiratory symptoms after travel was assessed among more than 1,000 passengers on aircraft that used 100 percent fresh air, compared with aircraft that recirculated a substantial portion of cabin air. The aircraft selected were similar and flew identical routes. The study found no evidence that aircraft cabin air recirculation increases the risk for upper respiratory infection."

The only way to eliminate the risk of transmission of infectious diseases through proximity to a disease-bearing passenger would be to prevent such passengers from flying, an impracticable task. "The risk would also be a lot easier to manage if people with known infectious diseases voluntarily postponed their air travel until they were no longer contagious," the report says. That, too, it acknowledges, is not likely among leisure travelers who would have to absorb the cost of non-refundable tickets and change their holiday plans.

But proximity transmission of infection can occur anywhere people congregate — shops, restaurants or theaters, for example. "Provided that the recirculation and filtration systems are working properly, the risk of transmission of infection [aboard] an aircraft is probably no greater than, and perhaps less than, other environments where large numbers of people are gathered closely together," the study says.

The problem of wide dispersal of infectious diseases such as influenza and tuberculosis through international air travel must be taken seriously. "With the possible threat of a new pandemic in the future, which may be more easily transmissible than SARS, a planned response involving the international aviation transport industry will be crucial to limiting both the loss of life and the economic cost resulting from such an outbreak," the report says. "While a pandemic flu situation could present much greater challenges than occurred with SARS, the experiences gained and lessons learned from the way the spread of SARS was managed at international airports has been invaluable in creating a pandemic plan."

WEB SITES

Canadian Aviation Executives' Safety Network, <www.tc.gc.ca/CivilAviation/regserv/affairs/caesn/menu.htm>

Canadian Aviation Executives' Safety Network (CAESN), established by Transport Canada, meets annually "to identify aviation safety challenges and mitigation strategies and to provide a forum for dialogue regarding the viability and direction of the aviation industry in Canada," the Web site says.

Annual meeting reports from 2003 through 2007 and presentations by industry executives and decision makers are free to view online and may be printed or downloaded. Topics include aviation safety, security and safety management systems.

Source

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Internet: <www.atsb.gov.au>

— *Rick Darby and Patricia Setze*

‘High and Fast’

Air ambulance overran short, slick runway.

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

Touchdown Occurred at Midfield

Cessna Citation 550. Substantial damage. One serious injury, three minor injuries.

The Citation was on a positioning flight from Winchester, Virginia, U.S., to Butler, Pennsylvania, to pick up a patient for an air ambulance flight the morning of Jan. 24, 2007. The copilot was flying the airplane from the left seat, according to the report by the U.S. National Transportation Safety Board (NTSB). She held a Citation type rating and had 1,951 flight hours, including 110 hours in type. The pilot-in-command (PIC) had 22,700 flight hours, including 1,200 hours in type.

Weather conditions at the airport included surface winds from 220 degrees at 3 kt, 2 1/2 mi (4,000 m) visibility, a few clouds at 100 ft, a broken ceiling at 1,100 ft and an overcast ceiling at 1,700 ft. Notices to airmen (NOTAMs) were in effect for fair braking action with thin snow and ice on the runway. “The PIC reported that he thought the runway might be covered with an inch or two of snow, which did not concern him,” the report said. “The copilot reported encountering light snow during the [instrument landing system (ILS)] approach.”

The PIC said that the Citation descended below the clouds about 2 mi (3 km) from the runway. “Both pilots stated that the airplane continued to descend toward the runway while on the glideslope and localizer,” the report said. “Neither pilot could recall the airplane’s touchdown point on the runway or the speed at touchdown.”

The approach was observed by the airport manager and a Citation 560XL pilot. They said that the airplane was “high and fast” as it crossed the threshold and touched down about halfway down the 4,801-ft (1,463-m) runway. The pilots had calculated a reference landing speed (VREF) of 106 kt. “Data downloaded from the airplane’s enhanced ground-proximity warning system (EGPWS) revealed that the airplane’s groundspeed at touchdown was about 140 kt,” the report said. “Review of the cockpit voice recorder [data] suggested that the PIC failed to activate the airplane’s speed brake upon touchdown.”

The PIC told investigators that he considered rejecting the landing but believed that there was insufficient runway remaining for a go-around. The Citation overran the runway, struck a wooden localizer antenna platform and the airport perimeter fence, and crossed a road before coming to a stop about 400 ft (122 m) from the runway. The PIC was seriously injured; the copilot and the two passengers received minor injuries.

“According to the airplane flight manual, the conditions applicable to the accident flight prescribed a VREF of 110 kt, with a required landing distance on an uncontaminated runway of approximately 2,740 ft [835 m],” the report said.

"The prescribed landing distance on a runway contaminated with 1 in [2.5 cm] of snow was approximately 5,800 ft [1,768 m]. At VREF plus 10 kt, the required landing distance increased to about 7,750 ft [2,362 m]."

Faulty Relay Precipitates Evacuation

Boeing 737-300. No damage. No injuries.

The aircraft was departing from Auckland, New Zealand, for a flight to Christchurch the morning of Sept. 12, 2006. When the first officer, the pilot flying, called for landing gear retraction, the captain was unable to fully move the gear lever to the "UP" position. "The captain advised air traffic control (ATC) that they had a technical problem and requested [and received] clearance to maintain runway heading," said the report by the New Zealand Transport Accident Investigation Commission.

After a brief discussion with the first officer, the captain returned the gear lever to the "DOWN" position and noticed that none of the three gear-position indicators illuminated. The captain requested and received clearance from ATC to level the 737 at 4,000 ft, below the cloud base. He attempted unsuccessfully to use the call button and the passenger-address system to summon the purser, and eventually attracted the purser's attention by opening the cockpit door. He briefed the purser on the situation and said that they would return to Auckland for a precautionary landing.

"The captain and first officer discussed the apparently escalating electrical malfunctions and agreed that they should land as soon as possible."

Electrical malfunctions continued to occur. None of the annunciator lights illuminated when they were tested, several fail lights illuminated on the overhead panel, and background color faded from the electronic flight instruments. "The captain and first officer discussed the apparently escalating electrical malfunctions and agreed that they should land as soon as possible rather than spend time trying to identify quick reference handbook (QRH) checklists that might address the situation," the report said.

The captain used the viewing panels to visually check the landing gear, which appeared to be down and locked. During the return to the airport, engine and fuel flow indications were lost, and the pilots were unable to arm the autobrakes. They were able to extend the flaps, however. After touchdown, the first officer was unable to select reverse thrust and used the wheel brakes to slow the 737 and bring it to a stop on a high-speed exit.

The pilots were taxiing the aircraft to the terminal when the purser told them that a "whitish grey smoke" was filling the cabin. "While there was no sign of fire, meaning no flame or heat, it would have been prudent for the captain to call for an immediate evacuation on the first report of smoke," the report said. Although the pilots detected light smoke and an unusual odor on the flight deck, they continued taxiing.

The purser soon returned to the flight deck and reported that the smoke in the cabin was getting thicker. "After a short discussion, the captain told the crew to prepare for evacuation," the report said. The evacuation was described as orderly and unrushed, and none of the 96 passengers and five crewmembers was injured.

Examination of the 737 showed that an electrical relay had failed, causing a loss of battery bus power. Investigators determined that the terminal post likely had been misaligned when the relay was manufactured in 1998, causing a larger-than-normal gap between the contacts. "Over time, the contacts overheated, causing arcing and fatigue," the report said. A solder junction at the base of the terminal post fractured, further increasing the gap between the contacts. "Eventually, there was sufficient vibration during the takeoff roll to cause the contacts to release and stop current flow to the battery bus," the report said.

The report noted that the corrective action for the relay failure was to select an alternate source of power for the battery bus. "A better first-hand knowledge of the contents of the QRH should have directed the pilots to the battery bus failure checklist, which would have resolved the emergency at an early stage of the flight."

Prolonged Flare Leads to Tail Strike

Boeing 757-200. Substantial damage. No injuries.

Visual meteorological conditions (VMC) prevailed at the destination — San Juan, Puerto Rico — on Sept. 5, 2006, and the crew decided to conduct an autoland approach to recertify the 757 for CAT III procedures. The NTSB report said, however, that the airline did not authorize autoland procedures if there was any restriction on the use of the localizer or glideslope. The ILS approach to Runway 08 at San Juan has such a restriction. The chart states: "ILS unusable 0.8 nm from threshold inbound."

"The crew reported, and the flight data recorder (FDR) confirmed, that the airplane began to drift off the centerline of the approach at about three-quarters of a mile from the runway threshold," the report said. "The drift was consistent with the direction of the wind and the ILS chart notation."

The first officer, the pilot flying, disengaged the autopilot and hand-flew the 757 toward the runway centerline. The report said that this maneuver prolonged the flare and that, during this time, the first officer inadvertently applied full nose-up trim. The tail struck the runway when the airplane touched down with a higher-than-normal pitch attitude about 4,000 ft (1,219 m) from the runway threshold. None of the 116 people aboard the 757 was hurt.

Toilet Chemicals Sicken Crewmembers

BAe 146-300. No damage. No injuries.

The flight crew noticed an unusual odor and experienced debilitating physical symptoms soon after departing from Belfast, Northern Ireland, for a positioning flight to Southampton, England, on Sept. 6, 2007. "The commander later described how he felt as similar to being inebriated and that he found it difficult to concentrate," the U.K. Air Accidents Investigation Branch (AAIB) report said. "The copilot initially felt she had reduced capacity to fly the aircraft, but this feeling quickly passed. One cabin crewmember felt lightheaded, sick and distressed. The other cabin crewmember felt tired and slightly sick."

The commander told the crew to don their oxygen masks and declared an emergency. While returning to Belfast, the pilots conducted the "Smoke and Fumes" checklist. The approach and landing were conducted without further incident.

Examination of the aircraft, which recently had undergone major maintenance, showed that the fumes likely originated from deodorizing chemicals that had been placed in the forward toilet. "The fumes may have been a result of formaldehyde, released as a degradation product of the [chemicals]," the report said. "In low concentrations, formaldehyde does not pose a toxic risk, but it can cause a feeling of lightheadedness and irritation to nose, throat, mouth and eyes."

Noting that the aircraft's yaw damper and thrust-balancing system were inoperative during the flight, the report said that the physical symptoms caused by the formaldehyde fumes might have been aggravated by motion sickness and anxiety.

Tug Driver Fails to Yield Right of Way

Bombardier CRJ200. Substantial damage. One serious injury.

The regional jet had landed at Chicago O'Hare International Airport the night of Dec. 16, 2007, and was passing the intersection of an airport service road while taxiing to the gate when the captain perceived that the airplane had hit something. "The captain brought the airplane to a stop, but at the time the flight crew could not see what they hit," the NTSB report said.

"The flight crew could not see what they hit."

The crew continued to taxi and, after turning onto another taxiway, saw an overturned tug on the taxiway they had vacated. "The tug driver was hospitalized for injuries [and] had no recollection of the events surrounding the accident," the report said.

The occupants of a van that was following the tug on the service road said that the tug did not stop at the intersection. The van driver said that the tug driver "may have realized that the airplane was coming at the last minute and tried to slam on the brakes, [but] the tug continued to slide forward [on the wet pavement]."

The report said that the airport requires ground vehicle operators to stop before crossing a taxiway and to yield the right of way to an aircraft in motion.

None of the 32 people aboard the CRJ was hurt. "A post-flight inspection by the first officer revealed impact damage to the leading edge of the right wing, within 4 ft [1.2 m] of the wing tip," the report said. "The damage extended aft to the forward wing spar."

Excess Thrust Leads to Overrun

Bombardier Challenger 604. Substantial damage. No injuries.

The commander was receiving instruction on the supervision of newly rated captains and was flying the Challenger from the right seat during the charter flight from Geneva to London Luton Airport on Feb. 5, 2006. During the stabilized approach to Runway 26 at Luton, the commander disengaged the autopilot about 300 ft above ground level (AGL) and the autothrottles at about 60 ft AGL. Engine fan speed (N_1) then increased to 64 percent and was not reduced, the AAIB report said.

The aircraft touched down in a shallow pitch attitude about 800 m (2,625 ft) from the end of the 2,160-m (7,087-ft) runway. "Both pilots stated afterwards that when the aircraft touched down, they considered that there was sufficient runway remaining to stop," the report said.

Groundspeed was about 35 kt when the Challenger ran off the end of the runway. "The nose and right main landing gear, running through soft earth approximately up to the depth of the axles, struck the vertical faces of [buried] concrete lighting bases upon which two Runway 08 approach lights were mounted," the report said. "The flight attendant and passenger, both seated in forward-facing passenger seats, were unaware of the incident until the aircraft was almost at a standstill, when the flight attendant noticed that the emergency exit lights had illuminated. With the aircraft at rest, both saw that there was grass, not runway, outside the aircraft."

Examination of the Challenger revealed no technical defects. The commander's lack of recent experience in flying the aircraft from the right seat might have been a factor in the incident, the report said. "It is concluded either that the commander selected a thrust lever angle which caused the engines to run at 64 percent N_1 or that he disconnected the autothrottle when the thrust levers were positioned to give approximately 64 percent N_1 and did not then retard them to the idle setting prior to the flare."

"The commander's lack of recent experience in flying the aircraft from the right seat might have been a factor."

Both pilots told investigators they believed that smooth landings were important with passengers aboard. Noting that the commander had placed both hands on the control yoke during the flare and landing at Luton, the report said, "It is possible that by doing this, he was able to make smoother, more accurate control inputs. Conversely, sensory feedback from the position of a hand on the thrust levers would provide a pilot with information about thrust lever position and movement."

After the accident, the operator published a flight crew bulletin stating: "A safe landing may well be gentle. However, a soft landing is not necessarily a safe one."

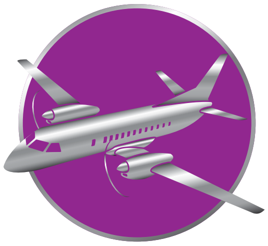
Open Door Provides Fatal Distraction

Cessna CitationJet. Destroyed. Two fatalities.

The copilot loaded the left front baggage compartment while the airplane was being refueled at Van Nuys (California, U.S.) Airport for a positioning flight to Long Beach the morning of Jan. 12, 2007. The fueler told the copilot that the airplane would have to be moved away from the fuel pumps before engine start. "He observed the [copilot] then shut the baggage door but not lock or latch it," the NTSB report said.

Witnesses said that the baggage door was "standing straight up" when the CitationJet was at about 200 ft AGL on takeoff. The airplane then stalled and crashed on a street. NTSB said that the probable cause of the accident was "the pilot's failure to maintain an adequate airspeed during the initial climb" and that a contributing factor was the copilot's "inadequate preflight."

"Several instances of a baggage door opening in flight have been recorded in Cessna Citation airplanes," the report said. "In some cases the door separated, and in others it remained attached. The crews of these other airplanes returned to the airport and landed successfully."



TURBOPROPS

Misset Switches Cause Electrical Failure

Beech King Air 100. No damage. No injuries.

While taxiing onto the runway at Montreal's Trudeau International Airport for a flight with four passengers to Saint-Hubert Airport, about 15 nm (28 km) east, the morning of Oct. 18, 2006, the pilots completed the last items on the line-up checklist. The copilot turned on the landing lights, and the PIC selected — what he thought were — the auto-ignition switches to the "ON" position.

"In fact, he mistakenly switched the ignition and engine start switches to the ignition and engine start position," said the report by the Transportation Safety Board of Canada. The two sets of switches are close together on the lower left subpanel and are difficult to see from the left-seat position and out of view from the right-seat position. Selection of ignition and engine start causes the starter/generators to function in the starter mode, leaving the electrical system to be powered only by the battery. Later King Air models were modified to show a warning of this, but the modification was not available for earlier models, including the incident airplane.

When the copilot moved the landing gear lever to the "UP" position after takeoff, the gear motor operated without sufficient torque to fully retract the gear. The PIC recycled the gear, but the gear-in-transit light remained illuminated, and the gear motor continued to operate and draw battery power.

Weather conditions included 3 mi (4,800 m) visibility, a broken ceiling at 1,000 ft and a 2,800-ft overcast. The departure procedure required an initial climb to 3,000 ft. The pilots decided to descend to 2,200 ft, which they believed was the minimum sector altitude (MSA). The MSA actually was 2,600 ft, but the pilots gained ground contact at 2,200 ft and flew an estimated heading toward Saint-Hubert Airport, which was not in sight.

While conducting the emergency gear-extension procedure, the pilots pulled the landing-gear circuit breaker, which reduced the load on the battery, with enough power remaining for use of the global positioning system receiver and to receive radio transmissions from ATC; the pilots responded to ATC transmissions by selecting the transponder ident mode.

The King Air was landed without further incident at Saint-Hubert about 27 minutes after its departure from Trudeau.

Descent Below MDA Ends Against Pole

Cessna 208B. Substantial damage. One serious injury.

The nighttime instrument meteorological conditions on Feb. 8, 2007, were below minimums for the nonprecision approaches to Alliance (Nebraska, U.S.) Regional Airport, the usual destination for the cargo flight, so the flight was dispatched to Western Nebraska Regional Airport near Scottsbluff, which had an ILS, the NTSB report said.

Nevertheless, the pilot requested and received clearance from ATC to conduct the VOR (VHF omnidirectional radio) approach to Alliance, which had 1 1/4 mi (2,000 m) visibility and a 200-ft overcast. Cockpit instrument settings and recorded radar data indicated that the pilot conducted the NDB (nondirectional beacon) rather than the VOR approach. Although the NDB was transmitting radio signals, a NOTAM stated that it was out of service and, therefore, should not be used.

During the NDB approach, the pilot descended below the minimum descent altitude (MDA) of 700 ft. The Caravan struck a building and a power line pole, and came to rest on a street.

One Engine Still Turning on Touchdown

Lockheed L188C Electra. No damage. No injuries.

Soon after lifting off from London Stansted Airport for a cargo flight to Edinburgh, Scotland, the night of March 19, 2007, the flight crew "became aware of the aircraft yawing, pitching and rolling erratically, combined with a loud fluctuating noise emanating from the propellers," the AAIB report said.

Propeller rpm, horsepower and other engine indications were fluctuating rapidly, and the temperature of the no. 2 and no. 4 engines increased above the limit. The commander reduced power on both engines until their temperatures were within limits. No. 2 engine propeller rpm then began to fall below the normal operating range, and the crew shut down the engine.

"Neither the pilots nor the engineer had experienced a similar situation before, and they tried to identify the nature of the problem," the report said.

The Electra was climbing through 3,000 ft when the commander declared an urgency and requested vectors to return to Stansted for the ILS approach. The speed of the remaining three propellers continued to fluctuate. "The aircraft also continued to yaw, pitch and roll, so much that the commander stated he had difficulty in reading the checklist," the report said. "The commander tried to adjust the power levers to see if it would have an effect, but the propeller rpm continued to fluctuate."

No. 3 engine propeller speed then stabilized at 14,300 rpm, about 480 rpm above normal. "The crew decided to leave the engine running with the intention of shutting it down on final approach," the report said.

The crew gained visual contact while turning onto final approach at 2,300 ft. "The pilots completed the landing checks and selected 100 percent flap with the aircraft decelerating through about 170 kt towards their planned two-engine approach speed of 150 kt," the report said. "As the aircraft descended through about 1,000 ft, however, both engines no. 1 and no. 3 appeared to flame out. The commander increased power on engine no. 4 to its maximum limit with the propeller rpm still fluctuating."

The Electra descended below the proper glide path, and airspeed decayed rapidly below 130 kt. "The aircraft touched down just short of the marked touchdown point and, after slowing on the runway, vacated via a high-speed turn-off onto a taxiway, where it was brought to a halt," the report said. The crew pulled the fire handles to shut down the no. 1 and no. 3 engine, and shut down the no. 4 engine normally.

Investigators found that the power and propeller rpm fluctuations had been caused by the overheating and failure of resistor connectors on the power supply circuit board in the propeller synchrophaser system. The power reductions, which the crew perceived as flameouts, actually were commanded by the governing system when propeller rpm reached the limit. "There was little to guide the crew in identifying the synchrophasing unit as being the cause," the report said.

PISTON AIRPLANES

Short-Field Takeoff Falls Short

Piper PA-60-601P. Destroyed. Six fatalities.

The Aerostar was near its maximum gross weight when the pilot attempted to take off from the 3,930-ft (1,198-m) runway at Lakeway (Texas, U.S.) Airpark on Aug. 3, 2004. Published performance data indicated that with the existing conditions, which included a high density altitude, the airplane would require 3,800 ft (1,158 m) to clear a 50-ft obstacle using short-field takeoff procedures including application of full power before brake release, said the NTSB report released in March 2008.

Several witnesses said that the engines sounded abnormally quiet during the takeoff roll and the airplane lifted off near the end of the runway. It clipped the tops of 30-ft (9-m) trees about 20 ft (6 m) from the departure threshold, entered a steep left bank, stalled, rolled inverted and exploded when it struck terrain.

The report said that the last annual inspection of the airplane had been initiated about 15 months before the accident. The maintenance technician had told the pilot, who owned a share of the Aerostar and managed the airplane, that the engine turbochargers were in "poor condition" and required replacement. "Before the mechanic could perform any maintenance to the airplane, the pilot contacted him and said that he needed the airplane and subsequently took possession of it before the annual inspection was completed," the report said.

The report also said that after a runway-overrun accident in April 2004, the U.S. Federal Aviation Administration (FAA) had told the pilot that a re-examination of his airman competency would be required, and the pilot's insurance company had placed a limitation on his policy requiring that he complete a certified Aerostar flight-training program or have a qualified pilot accompany him on flights in the airplane. The FAA re-examination had not been conducted before the August accident, and "there was no evidence that the pilot adhered to either of the insurance policy requirements," the report said.

Engines Starved for Oil

Beech C-45H. Destroyed. One serious injury, one minor injury.

The airplane, a military version of the Beech 18, was on an instructional flight from Hudson, Colorado, U.S., to Boulder the morning of July 19, 2007, when the left engine began to run rough and vibrate. The pilots shut down the engine and feathered the propeller. "Then the right engine began losing power," the NTSB report said. "Full power was applied, but the airplane continued to descend."

The airplane clipped the top of trees and was flown between two houses before it touched down in an open field, crossed a road, struck a power line pole and began to burn. The instructor pilot, who received serious injuries, and the trainee evacuated through the main cabin door.

Examination of the engines showed that they had failed catastrophically due to oil starvation. The C-45's engine rocker boxes must be drained before flight to prevent hydraulic lock. Investigators determined that the instructor pilot failed to close the valves after draining the rocker boxes before the accident flight. "There were two trails of oil leading from the parking spot down the taxiway and onto the runway," the report said.

HELICOPTERS

Gearbox Failure Downs EMS Flight

Bell 407. Destroyed. No injuries.

The emergency medical services (EMS) helicopter was en route at 6,500 ft in daytime VMC to the scene of an automobile accident in Warialda, New South Wales, Australia, on Feb. 2, 2007. About 28 km (15 nm) from the destination, the engine chip-detector warning light illuminated. "[The pilot] reported that approximately five seconds later, he heard a loud noise and the helicopter developed a severe high-frequency vibration with a complete loss of engine power," the Australian Transport Safety Bureau report said.

The pilot had to maneuver to avoid power lines during the emergency landing, and the 407 touched down hard and rolled onto its side. The pilot, crewman, physician and paramedic were not hurt.

"The investigation determined that the engine sustained an in-flight catastrophic failure of the engine gearbox," the report said. "The gearbox failure was due to the fracture and separation of a section of the helical torquemeter gear, which resulted in the complete loss of engine power." The engine had accumulated more than 3,200 service hours; nondestructive testing of the helical torquemeter gear was required during gearbox overhaul after 3,500 hours.

Improper Service Blocked Fuel Filters

Bell 206B. Substantial damage. One serious injury, one minor injury.

The engine lost power while the pilot was hovering the helicopter at 60 ft and a crewmember was operating a 30-ft (9-m) spray boom to clean power line insulators at Prudhoe Bay, Alaska, U.S., on Oct. 20, 2007. The pilot was seriously injured and the crewmember sustained minor injuries when the 206 descended rapidly to the ground.

Investigators found that the fuel inlet screens had been blocked by a fibrous material introduced during refueling. The mission required the helicopter to land every 7–8 minutes to be partially refueled and to refill the spray tank. "The contract fueler had routinely been shoving the fuel nozzle through a hole in the plastic packaging of a bundle of absorbent pads, into the edges of the pads, to keep fuel from dripping on the tundra," the NTSB report said.

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
June 1, 2008	Torino, Italy	Sikorsky S-64F	substantial	2 minor
The helicopter was scooping water from Lake Aviguana during an aerial fire-fighting demonstration when it inadvertently descended into the lake.				
June 1, 2008	Greensburg, Indiana, U.S.	Cessna 208B	substantial	1 none
All 14 parachutists jumped safely after the Caravan lost power while climbing through 7,000 ft. The airplane flipped over during the forced landing.				
June 7, 2008	Yeco, Chile	Cessna 208B	destroyed	1 fatal, 9 minor
The Caravan struck mountainous terrain in instrument meteorological conditions about 18 nm (33 km) from the destination during a charter flight from Puerto Montt to La Junta. The pilot was killed; the passengers were rescued four days later.				
June 8, 2008	Huntsville, Texas, U.S.	Bell 407	destroyed	4 fatal
The helicopter crashed in a forest soon after taking off from a hospital in Huntsville for an emergency medical services (EMS) flight to Houston in nighttime visual meteorological conditions.				
June 9, 2008	North Bimini, Bahamas	Aero Commander 500S	destroyed	1 none
Both engines failed during a positioning flight from Nassau to Fort Lauderdale, Florida, U.S. The pilot ditched the airplane in the ocean and exited into a life raft before the Commander sank in 40 ft (12 m) of water.				
June 10, 2008	Khartoum, Sudan	Airbus A310	destroyed	28 fatal, 186 NA
Thunderstorms were in the area when the Airbus overran the runway on landing and burst into flames.				
June 15, 2008	Chifeng, China	Harbin Yunshuji Y-12II	destroyed	3 fatal, 1 NA
The piston twin reportedly was on an aluminum-prospecting flight when it struck a hill.				
June 15, 2008	Swakopmund, Namibia	Cessna 210L	destroyed	6 NA
The airplane was returning from a charter flight when the engine lost power due to fuel starvation. The Cessna flipped over during the forced landing on rough terrain about 3 km (2 nm) from the airport. There were no reported fatalities.				
June 18, 2008	Durban, South Africa	Boeing 737-200	minor	93 NA
There were rain showers at the airport when the 737 landed long and skidded off the side of the runway. No fatalities were reported.				
June 18, 2008	Hyannis, Massachusetts, U.S.	de Havilland DHC-6	destroyed	1 fatal
The Twin Otter was about 200 ft above ground level during departure for a cargo flight when it rolled inverted and struck the ground.				
June 20, 2008	Bergen, Norway	Fairchild Merlin IIIB	destroyed	3 fatal
The Merlin was on a training flight in adverse weather when it crashed at sea.				
June 21, 2008	Krems, Austria	Antonov An-2R	destroyed	13 none
The airplane was taking off for a parachuting flight when it struck a tree and crashed in an open field.				
June 26, 2008	Jakarta, Indonesia	CASA 212	destroyed	18 fatal
The aircraft crashed in a forest during a flight from Jakarta to Bogor in adverse weather.				
June 27, 2008	Bolshoe Gryzlovo, Russia	Antonov An-2R	destroyed	5 fatal
The aircraft crashed in a wooded area while departing for an aerial-photography flight.				
June 27, 2008	Malakal, Sudan	Antonov An-12BK	destroyed	7 fatal, 1 NA
The aircraft crashed in adverse weather during a flight from Khartoum to Juba.				
June 28, 2008	Dmitrievskaya, Russia	Antonov An-2	destroyed	1 fatal
The aircraft crashed during a test flight following engine maintenance.				
June 29, 2008	Flagstaff, Arizona, U.S.	two Bell 407s	destroyed	6 fatal, 1 serious
The EMS helicopters collided during approach to Flagstaff Medical Center.				
June 30, 2008	Khartoum, Sudan	Ilyushin IL-76TD	destroyed	4 fatal
Witnesses reportedly said an engine was on fire when the cargo aircraft entered a steep left bank on takeoff and struck terrain.				

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.