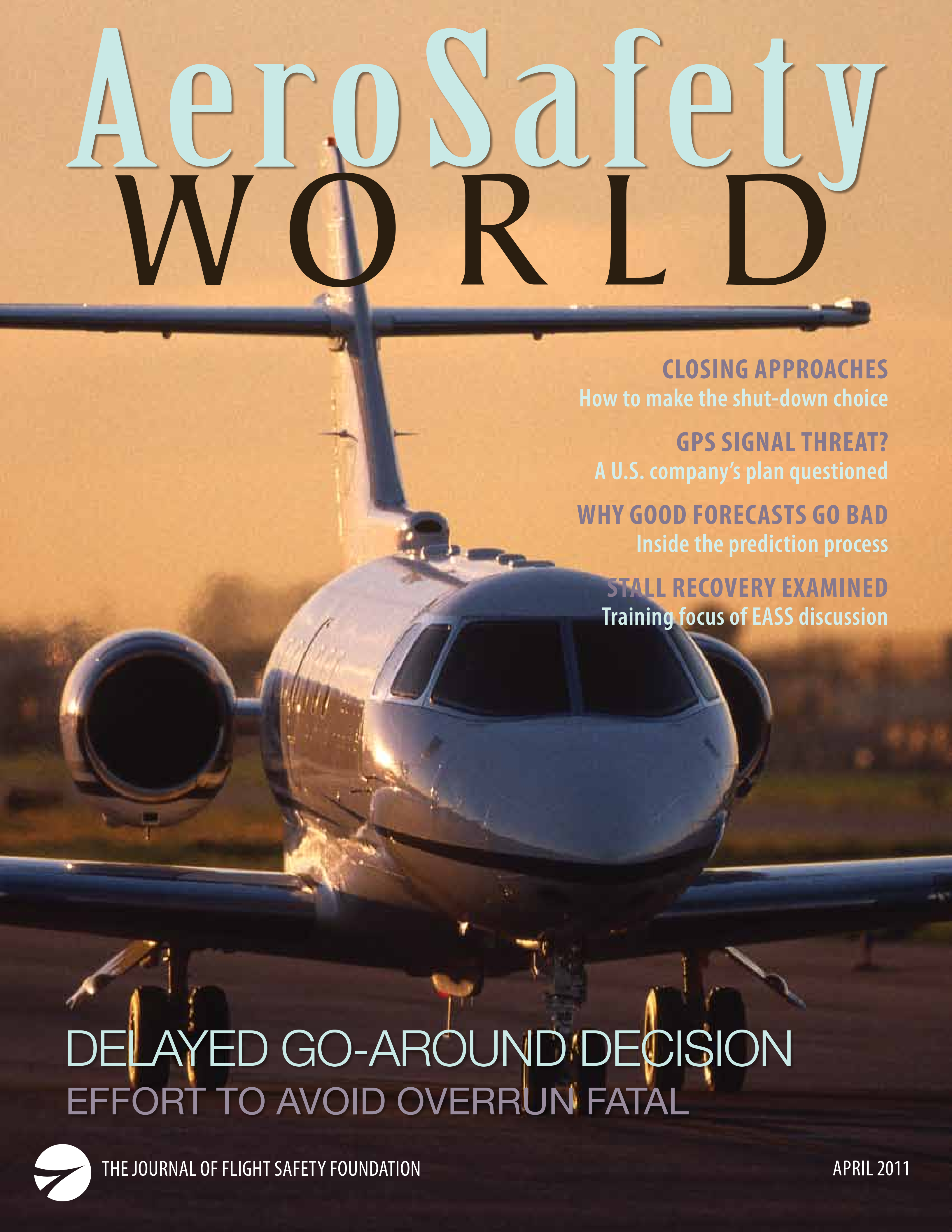


AeroSafety WORLD

CLOSING APPROACHES
How to make the shut-down choice

GPS SIGNAL THREAT?
A U.S. company's plan questioned

WHY GOOD FORECASTS GO BAD
Inside the prediction process

STALL RECOVERY EXAMINED
Training focus of EASS discussion

DELAYED GO-AROUND DECISION
EFFORT TO AVOID OVERRUN FATAL

CHANGING THE Conversation

One mission of this organization is to represent the global aviation safety community in the news media. We can go on the record and say things that might not be popular all of the time. In this regard, it's been an interesting few weeks for the communications staff at the Foundation.

There's no need to re-hash how the story of sleeping air traffic controllers grew as the number of occurrences multiplied, the traveling public got more concerned and the U.S. Department of Transportation (DOT) got more outraged. We in the United States saw a massive number of news stories. The amount of media coverage shouldn't surprise any of us.

What did surprise me was the immediate solution offered by DOT to put more staff in the towers, and the impression they gave that the problem was solved. I knew that solution had been tried in Canada, and it didn't work there. I also knew that there was good research being done into fatigue and how best to prevent or mitigate it. Why was no one talking about it?

Using the bully pulpit afforded by my position at the Foundation, I starting talking about fatigue and fatigue risk management systems in a real way. To the surprise of some of the interviewers, I called for controlled rest during breaks, much like an ER doctor or a firefighter might experience. It seemed logical to me, and the results of studies on this issue backed up this position. And the media were definitely paying attention.

Within a few days, the nature of the debate had shifted and more people started calling for science-based solutions. We saw sleep experts on the cable channels. Even DOT started saying that the additional staff in the towers is simply a first step.

Finally, the issue of fatigue was getting the airing it needed. We still don't know how DOT and the Federal Aviation Administration ultimately will act on the issue of sleep and controllers. They've dug in their heels on the controlled rest idea. It's gratifying, however, to know that we've helped force science into the debate.

I've been working on a speech that I'll be giving in a few weeks. It's a college commencement address, and I'm emphasizing the importance of standing up for what is right. Most of the time, in many parts of the world, what's "right" in aviation safety isn't met with too much debate. There is simply too much data and experience to argue against ideas like safety management systems and voluntary data sharing.

This time, however, what was "right" was politically incorrect and, at first, publicly unpopular; the idea of controller naps was mocked on late-night television. Someone had to stand up and take the punches for pointing out that the emperor has no clothes, and I'm proud that it was the Flight Safety Foundation.

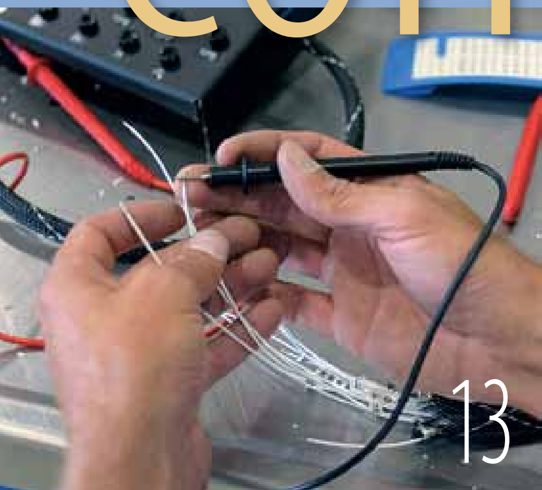
Aviation safety experts, for the most part, understand that punishing someone for falling asleep and staffing a second body in a tower that sees hardly any traffic overnight isn't the solution. The solution must be to determine the cause of the problem, figure out how to stop the problem, and in a worst case, determine how to safely mitigate it when it occurs. It is my hope that we've started the process of understanding fatigue in air traffic control, and that the regulators will allow the process to work.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafety WORLD

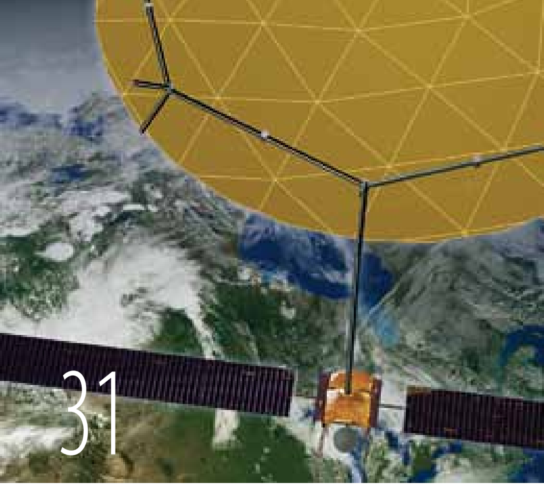
contents

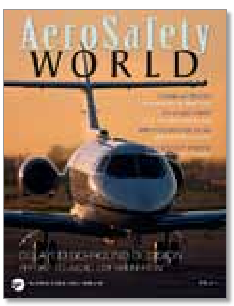
April 2011 Vol 6 Issue 3



features

departments





About the Cover
The Hawker 800 captain waited too long to go around.
© Chris Sorensen Photography

We Encourage Reprints (For permissions, go to <flightsafety.org/aerosafety-world-magazine>)

Share Your Knowledge

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

The publications staff reserves the right to edit all submissions for publication. Copyright must be transferred to the Foundation for a contribution to be published, and payment is made to the author upon publication.

Sales Contacts

Europe, Central USA, Latin America
Joan Daly, joan@dalyllc.com, tel. +1.703.983.5907

Northeast USA and Canada
Tony Calamaro, tcalamaro@comcast.net, tel. +1.610.449.3490

Asia Pacific, Western USA
Pat Walker, walkercom1@aol.com, tel. +1.415.387.7593

Regional Advertising Manager
Arlene Braithwaite, arlenetbg@comcast.net, tel. +1.410.772.0820

Subscriptions: Subscribe to *AeroSafety World* and become an individual member of Flight Safety Foundation. One year subscription for 12 issues includes postage and handling — US$350. Special Introductory Rate — $310. Single issues are available for $30 for members, $50 for nonmembers. For more information, please contact the membership department, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, +1 703.739.6700 or membership@flightsafety.org.

AeroSafetyWORLD
telephone: +1 703.739.6700

Select the Integrated Air Safety Management Software Solution...

...with the most **VALUE**

Best Practices: Integrated modules for Aviation Safety Management:
Document Control • Reporting • Audits • Training • Job Safety Analysis
CAPA • Safety Incident Reporting • Risk Assessment **...and more!**

Safety Assurance: Handles daily events, hazard analysis, and controls related to Aviation Safety Management

System Assessment & Corrective Action: Uses intelligent Decision trees to determine whether event conform to requirements, and take Corrective Action to known events

Safety Risk Management: Intuitive process for determining potential hazards using Job Safety Analysis, FMEA and similar tools

Risk Assessment: Identifies, mitigates, and prevents high-risk events in the Aviation Safety Management System

Change Control: Implement Controls to mitigate risks and Change Management to change processes related to known hazards

Integration: Integrates with 3rd party business systems

Scalable: Readily adapts to enterprise environments, and multi-site Deployments

Business Intelligence: Enterprise reporting tracks KPIs, aids in decision-making with hundreds of configurable charts and reports

EtQ
Excellence Through Quality

800-354-4476 • info@etq.com
www.etq.com/airsafety

SLIPPING Away

One of the toughest jobs connected with aviation safety is trying to convince operators that being safe today has little bearing on being safe tomorrow if continuous attention is not paid. This task gets even more difficult during periods of economic hardship.

This caveat is the same for regulators as it is for operators, but the consequences of a regulator's slipping focus are less obvious, reflected mostly in a secondary way when the state of an operator's compliance becomes noticeably lacking, which means that not only has the regulator failed to maintain standards, but the operator as well, an evil brew of circumstances.

So, when the European Union's (EU's) Safety Assessment of Foreign Aircraft (SAFA), that famous ramp inspection program, started to see German air carriers showing an increasing number of findings per inspection, the EU Air Safety Committee started a formal consultation with the German regulator, Luftfahrtbundesamt (LBA), as was reported in the April 20, 2011, edition of the *Official Journal of the European Union*.

An analysis of the problems SAFA found "revealed particular weaknesses in the oversight of these carriers." The inquiry also "pointed at insufficient numbers of qualified personnel within the LBA, thus impacting upon Germany's ability to ensure continuous oversight and limiting the LBA's ability to increase the level of oversight where necessary."

As alarming as this condition may be, this is even more troubling: "In terms of the lack of qualified staff, Germany informed the Air Safety Committee that no improvements would occur in 2011. However, an assessment of the LBA's personnel resources was underway and should conclude in spring 2011, therefore an improvement in the personnel situation is to be anticipated from 2012 onwards."

The EU Commission and the Air Safety Committee recognized that the LBA had taken steps to correct problems found during SAFA inspections, but concluded that if LBA "actions are ineffective in improving the performance of air carriers certified in Germany, action would be necessary to ensure that identified safety risks have been adequately controlled." It should also be noted that the Air Safety Committee issued this same warning to the Spanish regulator, also based on SAFA findings.

This is a startling situation, with warnings more typical of what is aimed at struggling developing nations than those in the heart of one of the most prosperous and aviation-savvy regions in the world.

But perhaps it shouldn't come as so much of a surprise, given the semi-thought-through way Europe is transitioning from each nation having a regulator to the creation of the overarching European Aviation Safety Agency (EASA), which is thinly staffed and dependent on the personnel at the national authorities.

The existence of the EASA must lessen the EU states' sense of obligation to field a sufficient, competent regulatory staff. Martin Chalk, president of the European Cockpit Association, reported at the Foundation's European Aviation Safety Seminar earlier this year that the staff of the U.K. Civil Aviation Authority's safety regulation group decreased from 831 people in 2002 to 579 in 2007 as airline traffic seat-kilometers increased 28 percent. "Similar changes can be found across the European continent. However, EASA's latest figures suggest that they have a total staff of only 460, of which 64 percent are in the finance, certification or executive directories," Chalk said.

Somehow, this situation must be corrected, probably by a combination of hiring and redefinition or clarification of responsibilities between EASA and the EU member states.

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

FLIGHT SAFETY FOUNDATION

OFFICERS AND STAFF

Chairman, Board of Governors	Lynn Brubaker
President and CEO	William R. Voss
Executive Vice President	Kevin L. Hiatt
General Counsel and Secretary	Kenneth P. Quinn, Esq.
Treasurer	David J. Barger

ADMINISTRATIVE

Manager, Support Services and Executive Assistant	Stephanie Mack

FINANCIAL

Chief Financial Officer	Penny Young
Accountant	Misty Holloway

MEMBERSHIP

Director of Membership and Seminars	Kelcey Mitchell
Seminar and Exhibit Coordinator	Namratha Apparao
Membership Services Coordinator	Ahlam Wahdan

BUSINESS DEVELOPMENT

Director of Development	Susan M. Lausch

COMMUNICATIONS

Director of Communications	Emily McGee

TECHNICAL

Director of Technical Programs	James M. Burin
Technical Programs Specialist	Norma Fields

INTERNATIONAL

Regional Director	Paul Fox

Past President	Stuart Matthews
Founder	Jerome Lederer 1902–2004

Serving Aviation Safety Interests for More Than 60 Years

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

MemberGuide

Flight Safety Foundation
Headquarters: 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA
tel: +1 703.739.6700 fax: +1 703.739.6708

flightsafety.org

Member enrollment	ext. 102
Ahlam Wahdan, membership services coordinator	wahdan@flightsafety.org
Seminar registration	ext. 101
Namratha Apparao, seminar and exhibit coordinator	apparao@flightsafety.org
Seminar sponsorships/Exhibitor opportunities	ext. 105
Kelcey Mitchell, director of membership and seminars	mitchell@flightsafety.org
Donations/Endowments	ext. 112
Susan M. Lausch, director of development	lausch@flightsafety.org
FSF awards programs	ext. 105
Kelcey Mitchell, director of membership and seminars	mitchell@flightsafety.org
Technical product orders	ext. 101
Namratha Apparao, seminar and exhibit coordinator	apparao@flightsafety.org
Seminar proceedings	ext. 101
Namratha Apparao, seminar and exhibit coordinator	apparao@flightsafety.org
Web site	ext. 117
Karen Ehrlich, webmaster and production coordinator	ehrlich@flightsafety.org

Regional Office: Level 6 • 278 Collins Street • Melbourne, Victoria 3000 Australia
Telephone: +61 1300.557.162 • Fax +61 1300.557.182

Paul Fox, regional director — fox@flightsafety.org

MAY 9–13 ➤ Advanced Aircraft Accident Investigation Short Course. Embry-Riddle Aeronautical University. Prescott, Arizona, U.S. <www.erau.edu/case>, <case@erau.edu>.

MAY 10–12 ➤ NextGen Ahead: Air Transportation Modernization Conference. *Aviation Week*. Washington, D.C. <www.aviationweek.com/events/current/nextgen/index.htm>.

MAY 10–20 ➤ Aircraft Systems Safety Management Course. (L/D)max Aviation. Dayton, Ohio, U.S. Sharon Morphew, <sharon.morphew@ldmaxaviation.com>, <www.ldmaxaviation.com/Courses/Systems_Safety_Courses/Aviation_System_Safety_Management_%28ASSM%29>, 877.455.3629, +1 805.285.3629.

MAY 16–19 ➤ Regional Airline Association (RAA) Annual Convention. RAA. Nashville, Tennessee, U.S. <raa@raa.org>, <www.raa.org/2011AnnualConvention/tabid/171/Default.aspx>, +1 202.367.1170.

MAY 16–20 ➤ Human Factors Investigation Course. (L/D)max Aviation. Torrance, California, U.S. Sharon Morphew, <sharon.morphew@ldmaxaviation.com>, <www.ldmaxaviation.com/Courses/Aircraft_Accident_Investigation_Courses/Human_Factors_Investigations_%28HFI%29>, 877.455.3629, +1 805.285.3629.

MAY 16–20 ➤ Safety Management Systems Complete Course. Southern California Safety Institute. Prague, Czech Republic. Mike Doiron, <mike.doiron@scsi-inc.com>, <www.scsi-inc.com/safety-management-systems-complete.php>.

MAY 16–20 ➤ Notification and Family Assistance Intensive Workshop and Live Exercise. Fireside Partners. New Castle, Delaware, U.S. <info@firesideteam.com>, <www.firesideteam.com/index.cfm?ref=60200&ref2=17>, +1 302.747.7127.

MAY 17–19 ➤ European Business Aviation Convention and Exhibition (EBACE). European Business Aviation Association and National Business Aviation Association. Geneva. Romain Martin, <rmartin@ebaa.org>, +32 2 766 0073; Donna Raphael, <draphael@nbaa.org>, +1 202.478.7760; <www.ebace.aero/2011>.

MAY 18–19 ➤ Initial Human Factors in Aviation Workshop. Bristow Academy and Grey Owl Aviation Consultants. Titusville, Florida, U.S. Richard Komarniski, <Richard@greyowl.com>, <www.greyowl.com/calendar/phase1-may2011.pdf>, +1 204.848.7353.

MAY 20 ➤ Human Factors in Aviation Workshop: Recurrent Phase II. Bristow Academy and Grey Owl Aviation Consultants. Titusville, Florida, U.S. Richard Komarniski, <Richard@greyowl.com>, <www.greyowl.com/calendar/phase2-may2011.pdf>, +1 204.848.7353.

MAY 23–27 ➤ Investigation in Safety Management Systems Course. Southern California Safety Institute. Prague, Czech Republic. Mike Doiron, <mike.doiron@scsi-inc.com>, <www.scsi-inc.com/ISMS.php>.

MAY 23–27 ➤ Accident and Incident Investigation Course. ScandiAvia. Stockholm. Morten Kjellesvig, <morten@scandiavia.net>, <scandiavia.net/index.php/web/artikkel_kurs/investigation_sto_2011_01>, +47 9118 41 82.

MAY 24–26 ➤ Global Runway Safety Symposium. Civil Air Navigation Services Organisation and International Civil Aviation Organization. Montreal. Details to be announced. <www.canso.org/cms/showpage.aspx?id=2118>.

MAY 24–27 ➤ Airmed Congress. Kent, Surrey and Sussex Air Ambulance, European HEMS and Air Ambulance Committee. Brighton, East Sussex, England. <info@airmed2011.com>, <www.airmed2011.com/>, +44 (0)1622 833833.

MAY 30–JUNE 1 ➤ Human Factors in Aviation Maintenance Course. Southern California Safety Institute. Prague, Czech Republic. Mike Doiron, <mike.doiron@scsi-inc.com>, <www.scsi-inc.com/HFAM.php>.

JUNE 6–8 ➤ Aviation Fatigue Research Roadmap: Building a Bridge Between Research and Operational Needs. MITRE Corp. McLean, Virginia, U.S. <www.aviationfatigueregistration.aero>.

JUNE 6–8 ➤ Air Charter Summit. National Air Transportation Association. Chantilly, Virginia, U.S. (near Washington Dulles International Airport). <www.nata.aero/Events/Air-Charter-Summit.aspx>, 800.808.6282, +1 703.845.9000.

JUNE 9–10 ➤ Asia Pacific ANSP Conference. Civil Aviation Navigation Services Organisation. Bangkok, Thailand. Anouk Achterhuis, <Anouk.Achterhuis@canso.org, www.canso.org/asiapacificconference>, +31 (0)23 568 5390.

JUNE 14–16 ➤ Emergency Response Bootcamp. Fireside Partners. New Castle, Delaware, U.S. <info@firesideteam.com>, <www.firesideteam.com/index.cfm?ref=60200&ref2=16>, +1 302.747.7127.

JUNE 17–18 ➤ A Practical Approach to Safety Management Systems Course. Beyond Risk Management. Dallas–Fort Worth, Texas, U.S. Capt. Elaine Parker, <Elaine@beyondriskmgmt.com>, <www.regonline.ca/builder/site/Default.aspx?EventID=969548>; Brendan Kapuscinski, +1 403.804.9745.

JUNE 20–26 ➤ 49th International Paris Air Show. Salon International de l'Aeronautique et de l'Espace. Le Bourget, France. <www.paris-air-show.com>.

JUNE 27–28 ➤ Aviation Safety Management Systems Overview Workshop. ATC Vantage. Tampa, Florida, U.S. Theresa McCormick, <info@atcvantage.com>, <www.atcvantage.com/sms-workshop.html>, +1 727.410.4759.

JUNE 29 ➤ Transitioning to EASA Requirements for Operators. Baines Simmons. Chobham, Surrey, England. Zoe Martin, <zoe.martin@bainessimmons.com>, <www.bainessimmons.com/directory-course.php?product_id=134>, +44 (0)1276 855412.

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

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

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

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

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

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

Reinvestigate the Tu-154 Crash?

I am grateful that you found the crash of a Polish [Tupolev] Tu-154 worth an article (*ASW*, 2/11, p. 20). It is vital in light of demands expressed by some local politicians for a new investigation.

What looks to be a textbook example of a classic controlled flight into terrain, where violation of procedures led to the accident, is now gaining an increased number of supporters of a ridiculous assassination plot theory.

The political and historical background links the crash to the atrocities suffered by the Polish people at the hands of the Russians. Those circumstances cause the final report published by the Russian Interstate Aviation Committee to be considered false and rejected.

To stop the turmoil, sooner or later some independent international body will have to get involved to verify the findings. This is the only way all factors leading to the accident can be identified and accepted, and preventive actions made obligatory to make sure that such an accident will not happen again.

Martin Dzieciuchowicz

Doing Not Quite the Right Thing?

The photo of the two mechanics with the article "Do the Right Thing" (*ASW*, 2/11, p. 27) may not be illustrating what the article recommends.

The mechanic on the engine has no fall protection or fall restraint. The U.S. Occupational Health and Safety Administration (OSHA) requires general industry to have fall protection or fall restraint for work above 4 feet [1.2 meters]. And the individual below does not have eye protection on, but the one above on the engine does. So what is the policy in this workplace and who is looking out for whom? Compliance or noncompliance … or a little of both?

John Baxt
Director of Safety, Koch Aviation

TERPS Changes

I have read with interest the article "Dangerous Approaches" (*ASW*, 2/11, p. 38). I believe your effort to promote more knowledge of approach design criteria is very important.

I would like to bring to your attention that the U.S. Federal Aviation Administration TERPS [*U.S. Standard for Terminal Instrument Procedures*] has changed over the years and to highlight especially change 21, effective from June 5, 2009. One part of the revision was the radius to draw the circling area. Table 1 in the article (p. 42) refers to the old version of TERPS, which defines a smaller radius, a constant per given aircraft category.

Change 21 of TERPS introduces a radius that is a function not only of the fixed parameters of indicated airspeed, bank angle and straight segment, but also introduces the true airspeed, dependent on airport elevation and the height above the airport.

The radius calculated by the formula of change 21 will be larger than the fixed one provided in change 18, but still smaller than the one calculated by International Civil Aviation Organization PANS-OPS [*Procedures for Air Navigation Services — Aircraft Operations*] due to the different bank angle assumptions and the use of higher visual maneuvering indicated airspeeds for the calculation.

It may not be clear whether published procedures have been revised to reflect the latest changes to TERPS.

Tzvetomir Blajev
Eurocontrol

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

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

Safety News

Control-Tower Supervision

Air traffic controllers should not be permitted to work as supervisors at the same time they are performing operational air traffic control duties, the U.S. National Transportation Safety Board (NTSB) says.

In its recommendation to the U.S. Federal Aviation Administration (FAA), the NTSB cited several accidents and incidents that occurred while the supervisory controller was also performing air traffic control (ATC) operational duties.

"In many instances, a sufficient number of personnel were on duty at the time of the events such that another qualified controller could have been designated to supervise," the NTSB said. "However, ATC management's decisions concerning staffing utilization resulted in a lack of distinct supervisory oversight, thus diminishing or eliminating the effectiveness of the supervisory role."

In one of the events cited, a Eurocopter AS 350BA and a Piper PA-32R-300 collided over the Hudson River near Hoboken, New Jersey, U.S., on Aug. 8, 2009, killing all nine people in the two aircraft. At the time, a developmental controller was working in the flight data and clearance delivery positions in the Teterboro Airport (TEB) control tower, and a local controller working in ground control/arrival radar positions also was designated as controller-in-charge (CIC). Two other controllers — a qualified CIC and a front-line manager/supervisor — were on breaks at the time of the accident.

"About three minutes before the accident, the TEB local controller initiated a nonpertinent telephone call to airport operations while continuing to provide instructions to the airplane pilot, including a delayed instruction to switch to the EWR [Newark Liberty International Airport] tower frequency that the pilot read back incorrectly and the controller did not correct," the NTSB said.

In its final report on the accident, the NTSB said the probable cause was the controller's "nonpertinent telephone conversation, which distracted him from his air traffic control duties."

The NTSB noted that in another of the events cited, a controller was working alone on the midnight shift "and was therefore responsible for supervising himself." In most of the other events cited, the controller who committed

U.S. National Aeronautics and Space Administration

the error was also the CIC, the NTSB said, concluding that "the effectiveness of the supervisory role is reduced when it is performed in combination with operational duties, leading to operational errors, incidents and accidents."

The NTSB's issuance of the recommendation coincided with reports of events in which lone controllers in airport traffic control towers apparently fell asleep during the midnight shift, leaving pilots to land without controller assistance. The NTSB was investigating, and the FAA said in mid-April that it was placing an additional controller on the midnight shift at 27 control towers where that shift previously was staffed by a single controller.

Seaplane Safety

The Transportation Safety Board of Canada (TSB), citing the fatal Nov. 29, 2009, crash of a Seair Seaplanes de Havilland DHC-2 Beaver, is calling for all seaplanes to be equipped with exits to allow occupants to deplane quickly after an accident.

The TSB also recommended that every occupant be required to wear "a device that provides personal flotation following emergency egress."

Gordon E. Robertson/Wikimedia

Six of the eight people in the accident seaplane drowned inside the aircraft, which crashed during takeoff from Lyall Harbour, British Columbia. The two others were seriously injured.

The TSB said that, from 1989 through 2010, 76 people were killed in 109 seaplane accidents. The agency also said that drowning accounted for about 70 percent of all fatalities involving aircraft that crashed and sank in water in the past 20 years.

Fifty percent of people who survived such crashes were unable to exit the aircraft and drowned inside, the TSB said.

"In this accident, two occupants were able to escape from the aircraft, but neither managed to retrieve a life vest," the TSB added. "Had they not found nearby boat bumpers to stay afloat, they could easily have drowned. It has been shown that those inside a sinking aircraft either do not have enough time to locate and don a life vest or overlook doing so. Of those who do not survive following escape, 86 percent drown."

Volcanic Ash Planning

One year after air traffic was grounded by the eruption of Iceland's Eyjafjalajökull volcano, the aviation community staged a two-day simulation exercise to assess changes in volcanic ash contingency plans developed by the International Civil Aviation Organization (ICAO) and European authorities.

The simulation exercise — with participation from more than 70 airlines, 14 air navigation service providers, 10 national regulatory authorities, the Volcanic Ash Advisory Centre London, Eurocontrol, the European Aviation Safety Agency (EASA) and the European Commission — was designed, in part, to measure the effectiveness of a new plan based on revised ICAO guidelines for alerting flight crews when an eruption occurs and for procedures to be followed if airspace must be closed. Actual flights were not affected by the exercise.

Árni Friðriksson/Wikimedia

The previous guidelines "had proved unsuitable [during the eruption in April 2010] as they were based on a very strict precautionary principle," the European Commission said.

The April 14, 2010, eruption led to the closure of more than 300 airports, the cancellation of 100,000 flights and the grounding of 10 million passengers until the airspace was gradually reopened beginning April 20. Several more shutdowns occurred on a smaller scale during the following weeks (*ASW*, 11/10, p. 12).

The two-day exercise was based on the simulated eruption of a different Icelandic volcano and the simulated spread of volcanic ash across European airspace and across the North Atlantic.

During the first day of the exercise, different countries requested that Eurocontrol open their airspace, or institute closures or restriction, based on current national procedures. The second day, the new plans were tested, allowing airlines to decide — using a safety risk assessment accepted by their national supervisory authority — whether to conduct scheduled flights.

A continent-wide assessment session is planned in June to discuss lessons learned and possible follow-up actions.

"The intensive efforts of the last 12 months have paid off in terms of improving crisis planning and systems," said Siim Kallas, European Commission vice president responsible for transport. "But the work goes on. Volcanoes and other aviation crises are by their nature unpredictable, and each one will be different. We can never get to zero risk, but we can make maximum efforts to prepare strong systems to cope with disasters."

Project Leader

Bob Whetsell, vice president of sales at Aerobytes, has been named project leader of Flight Safety Foundation's helicopter emergency medical services (HEMS) project.

The project, which began in 2009, is studying flight operational quality assurance in HEMS. The effort is financed by a grant to the Foundation from the estate of Manuel S. Maciel, the founder of Manny's Sonoma Aviation, a full-service fixed base operator at the Charles M. Schulz Sonoma County Airport in Santa Rosa, California, U.S.

"Our HEMS project will ultimately result in important improvement in the safety of the helicopter EMS industry," said FSF President and CEO William R. Voss.

HEMS Goals

© Mesha Photo/iStockphoto

Associations representing various segments of the helicopter emergency medical services (HEMS) community have adopted data-driven recommendations developed by the International Helicopter Safety Team (IHST) to improve the industry's safety record.

The associations said that leading HEMS operators already have made major investments in safety programs that are "a starting point in a long-term commitment to safer medical aviation."

Signers of the agreement represented HEMS associations in Australia, Europe and North America.

The IHST was established in 2005 with the goal of achieving an 80 percent reduction in the global helicopter accident rate by 2016. The IHST said that it is working toward that goal "by developing means of eliminating or mitigating factors that contribute to accidents based on the thorough and disciplined analysis of those accidents."

Inspections Ordered

In the aftermath of an explosive decompression and fuselage tear in a Southwest Airlines Boeing 737, the U.S. Federal Aviation Administration (FAA) has ordered inspections of about 175 similar aircraft.

The FAA issued an emergency airworthiness directive (AD) telling operators to conduct initial electromagnetic inspections for fatigue damage and then to conduct follow-up inspections.

“The FAA has comprehensive programs in place to protect commercial aircraft from structural damage as they age,” FAA Administrator Randy Babbitt said. “This action is designed to detect cracking in a specific part of the aircraft that cannot be spotted with visual inspection.”

Canyon Blue/Wikimedia

The AD applies to about 175 airplanes worldwide, including about 80 U.S.-registered 737s. Most of the affected 737s in the United States are operated by Southwest Airlines, including the airplane involved in the April 1 decompression.

The decompression occurred at Flight Level 340 (approximately 34,000 ft) during a flight from Phoenix to Sacramento, California. The crew diverted to Yuma, Arizona, for an emergency landing. A flight attendant — one of 122 people in the airplane — received minor injuries during the descent. After landing, the crew discovered a 5-ft by 1-ft (1.5-m by 0.3-m) hole in the top of the airplane.

After the accident, Southwest grounded 81 of its 737s for inspections.

The FAA implemented new rules earlier this year requiring the development of inspection programs to detect widespread fatigue damage, in which small cracks form and then grow quickly and join together, sometimes causing structural damage before they are detected (*ASW*, 3/11, p. 37).

African Priorities

Citing a continent-wide accident rate 12 times higher than the global average for large commercial jets, the International Air Transport Association (IATA) is calling for an increased emphasis on safety in Africa.

Hansueli Krapf/Wikimedia

IATA data show that Africa had an accident rate in 2010 of 7.41 accidents per million flights, compared with a 2009 rate of 9.94. The 2010 average accident rate worldwide was 0.61.

IATA noted that, for African air carriers that had undergone an IATA Operational Safety Audit (IOSA), the accident rate was more than 50 percent lower than the accident rate for those that had not.

During an IATA-sponsored conference in Lagos, Nigeria, IATA also called for development of infrastructure to support the growth of performance-based navigation (PBN), which establishes performance requirements for any given flight operation and involves a shift to satellite-based navigation and area navigation procedures. The International Civil Aviation Organization has set a goal of worldwide implementation of PBN by 2025.

In Other News …

Representatives of the pilots union at Air Wisconsin have stopped participating in the airline’s **aviation safety action program** (ASAP), complaining that the airline was trying to “circumvent” the confidential safety-reporting effort. … The European Aviation Safety Agency (EASA) has proposed changes in certification specifications intended to better protect large airplanes and turbine engines being flown in **icing conditions**. … The Nigerian Civil Aviation Authority (NCAA) and AeroMechanical Services/Flyht of Calgary, Alberta, Canada, have commissioned the NCAA **Flight Tracking** Operations Command Centre (OCC) in Lagos.

Compiled and edited by Linda Werfelman.

Incidents of counterfeit parts in the electronics industry more than doubled between 2005 and 2008, according to the Aerospace Industries Association (AIA), which is urging action to reduce the associated risks in the aviation industry.

The AIA, in a report released in March, cited a 2010 study by the Bureau of Industry and Security (BIS) in the U.S. Department of Commerce that found more than 8,000 incidents of counterfeit parts in the U.S. electronics industry in 2008, compared with 3,300 incidents in 2005.[1]

"This sharp increase in incidents, in only three years, clearly indicates that the volume of counterfeit parts is increasing and mitigation plans must be developed and implemented," the report said.

"Regardless of how counterfeit parts — whether electronic, mechanical or other — enter the aerospace and defense supply chain, they can jeopardize the performance, reliability and safety of aerospace and defense products. Authentic parts have known performance histories and adhere to the manufacturers' quality control plans, whereas counterfeit parts have unknown performance reliability and, often, limited quality controls."

The report identified "unique conditions" — in addition to profit — that have contributed to the counterfeiting of aerospace products, including the long life cycles of aircraft. As an example, the report cited the Boeing 737, which entered service in 1968; its retirement date has not been determined.

The decreasing numbers of component manufacturers and issues involving shortages of materials also play a role in the production of counterfeit parts, the report said.

During an aircraft's long life cycle, technologies change — especially technologies involving microchips and other electronic components, the report said.

"Currently, during the design, production and service life of an aircraft,

© Mihail Glushkov/iStockphoto

BY LINDA WERFELMAN

An influx of counterfeit parts has prompted an industry group to recommend ways of curbing risks.

BAD PARTS

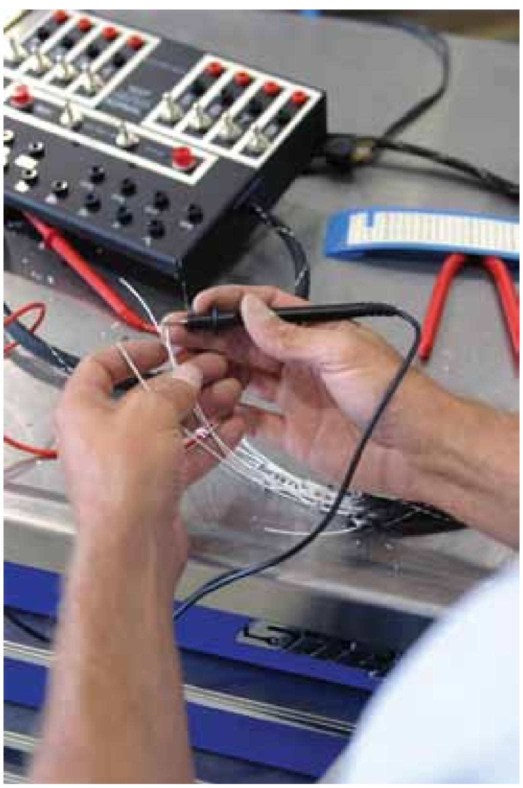
the computers used to design and support it will change nine or more times," the report said. "The software used to design and support … the aircraft and the infrastructure used to store, transmit [and] receive information and communications will all change three times or more. Manufacturing processes used to assemble the aircraft will change two or more times, and the system[s] and subsystems used in the aircraft will change nine or more times."

As a result, these aircraft sometimes need parts that may no longer be available from the original manufacturer or other authorized manufacturer, distributor or reseller, the report said.

Companies should develop plans for disposing of known or suspected counterfeit parts.

"When parts and materials, such as microcircuits, are acquired through distribution channels other than those franchised or authorized by the original manufacturer, such as an independent distributor or broker, there is the potential to receive parts that do not meet the original specifications," the report said.

In these situations, an electronic part could be "a fake non-working product," a new product labeled as being of a higher grade or an invalid part, the report said, citing the BIS study.



© Chris Sorensen Photography

Although the aerospace industry accounts for less than 1 percent of the world's semiconductor market, counterfeit electronic parts present risks to safety, the report said, adding, "This lack of leverage for electronic parts makes the necessary task of mitigating risks difficult and expensive."

The AIA, in the aftermath of a series of meetings on the subject that began in 2007, recommended that the industry adopt procedures described by SAE Aerospace Standard AS5553, which outlines steps for reducing counterfeit electronic parts in the supply chain. The steps are used by the U.S. Department of Defense and the National Aeronautics and Space Administration, the report said.

The AIA also recommended that the aviation industry develop purchasing processes aimed at reducing the likelihood of acquiring counterfeit parts. The association called for development of a qualified suppliers list for distributors (QSLD), which would include only distributors that had undergone a quality process assessment to verify that they had "the necessary processes in place to be able to mitigate the risk of receiving, storing and shipping potential counterfeit devices," the AIA said.

Other AIA recommendations called for distributors to maintain easily accessible records to allow the history of their components to be traced to the original manufacturer.

Reporting Processes

Although the reporting of counterfeit components is crucial, companies sometimes do not consistently report their discoveries to those outside their organizations, the AIA said. A mid-2008 survey of AIA committees found that most respondents were members of the Government–Industry Data Exchange Program (GIDEP), which aims to reduce resource expenditures through the sharing of technical information.

The AIA report noted that GIDEP asks members to report suspected counterfeit parts and to identify the supplier but added that its survey found that GIDEP members are "hesitant or not permitted to identify the supplier due to potential legal issues or other concerns." If the supplier is not identified, however, GIDEP cannot alert other companies that may have acquired the same components from the same supplier, the report said.

Among a handful of similar reporting programs is the U.S. Federal Aviation Administration's (FAA's) Suspect Unapproved Parts Program (SUP) (Table 1). When companies submit a report to the SUP, the FAA investigates and publishes its conclusion on the FAA Web site as an "unapproved parts notification."

The AIA recommended that companies and government agencies file their reports to a common database "so the extent of the problem of counterfeit parts in the supply chain can be known and the proper response can be undertaken." The use of GIDEP has several advantages, the report said, including that it is managed by a federal agency — which means that it can "protect sensitive information or the detection methods used to identify counterfeit parts or materials" — and that it is not fee-based.

Disposing of Counterfeit Parts

Companies should develop plans for disposing of known or suspected counterfeit parts, and government agencies should develop guidance for disposal, the report said.

"Proper disposition … prevents their reintroduction into the supply chain," the report said, warning that if a counterfeit part is returned to the supplier, it might be re-sold. In addition, returning a counterfeit part "allows counterfeiters to learn that their attempts were detected."

FAA recommendations call for mutilating scrap parts "to prevent misrepresentation," the report said. "Mutilation includes grinding; burning; removal of a major integral feature; permanent distortion of parts and materials; cutting a significant size hole with a cutting torch or saw; melting; sawing into many small pieces; and removing manufacturer identification, part, lot batch and serial number. Removing the identification and part markings without rendering the part useless is not an acceptable option and increases the opportunity for counterfeiting."

Obsolescence

The report also recommended that the industry "take proactive steps to deal with component obsolescence." The recommended actions included the use of life cycle analysis tools to predict "when components are in the last phases of their life cycle and are heading toward obsolescence and may become difficult to obtain and require acquisition through non-franchised sources."

Information Sources for Reports of Counterfeit Parts

SUP Reporting	GIDEP Reporting
Reported by industry participants to FAA	Cooperative effort between government and industry participants for any project or program
Contains part information	Contains part information
Affected part or material	Affected part or material
Description of failure	Description of failure/how identified as counterfeit
No rebuttal after FAA investigation	Provides time for rebuttal of report
Not searchable — only FAA investigated reports posted	Searchable reports
Voluntary reporting	Voluntary reporting
Only for FAA-related activities	Applicable to all branches of U.S. government

FAA = U.S. Federal Aviation Administration; GIDEP = Government Industry Data Exchange Program; SUP = FAA Suspected Unapproved Parts Program

Source: Aerospace Industries Association

Table 1

Other recommendations called on the aviation industry to develop counterfeit parts control plans to document "processes used for avoidance, detection, risk mitigation, disposition and reporting of counterfeit parts" and to work with government and various organizations to create standards for mechanical parts and materials.

Another recommendation asked the industry to develop training programs to help employees in detecting, reporting and disposing of counterfeit parts. In addition, the report called for passage of legislation to enable the U.S. Customs and Border Protection agency to "consult trademark rights holders … for assistance in determining whether or not imported goods are authentic."

This article is based on the AIA report, Counterfeit Parts: Increasing Awareness and Developing Countermeasures, *published in March 2011.*

Note

1. U.S. Department of Commerce, BIS Office of Technology Evaluation. "Defense Industrial Base Assessment: Counterfeit Electronics." January 2010. Cited in the AIA's *Counterfeit Parts: Increasing Awareness and Developing Countermeasures.*

© Chris Sorensen Photography

Too Late to Go

Faced with an imminent overrun, a Hawker captain attempted a go-around.

BY MARK LACAGNINA

Establishing "committed-to-stop" points on landing for turbine airplanes and allowing pilots to use prescription sleep medications to counter insomnia were among the recommendations generated by the investigation of a Hawker 800A accident in Owatonna, Minnesota, U.S., that killed all eight people aboard and destroyed the airplane on July 31, 2008.

In its final report, the U.S. National Transportation Safety Board (NTSB) said that the probable cause of the accident was "the captain's decision to attempt a go-around late in the landing roll with insufficient runway remaining."

Factors contributing to the accident were "the pilots' poor crew coordination and lack of cockpit discipline; fatigue, which likely impaired both

The Hawker's lift-dump system greatly increases aerodynamic drag on landing by extending the airbrake panels and the flaps beyond their normal ranges.

pilots' performance; and the failure of the Federal Aviation Administration (FAA) to require crew resource management (CRM) training and standard operating procedures (SOPs) for [U.S. Federal Aviation Regulations] Part 135 operators."[1]

The Hawker, operated by East Coast Jets, had been chartered by Revel Entertainment to transport six employees to Owatonna from Atlantic City, New Jersey. Founded in 1999 and based in Allentown, Pennsylvania, East Coast Jets employed 22 full-time pilots and operated four Hawkers and six Learjets. The company had no previous accident history.

The captain assigned to the flight was 40 years old and had about 3,600 flight hours, including 1,188 hours as a Hawker pilot-in-command and 874 hours as a Learjet PIC. He was a flight instructor before being hired by East Coast Jets in January 2005.

The first officer, 27, had about 1,454 flight hours, including 295 hours as a Hawker second-in-command and 2 hours as a Learjet SIC. He was a corporate pilot before joining East Coast Jets in October 2007.

The airplane departed from Allentown at 0600 Owatonna time (0500 local) for the positioning flight to Atlantic City. After the passengers were boarded, it left Atlantic City at 0713 for the flight to Owatonna. The captain was the pilot flying.

Skirting a Squall Line

An area of severe weather called a "mesoscale convective complex" lay between the Hawker and Owatonna as the airplane neared southern Minnesota from the east. At the leading edge of the severe weather was a squall line that had passed over the airport about an hour earlier, leaving behind an extensive area of scattered thunderstorms and light to moderate precipitation.

A controller at Minneapolis Center asked the crew if they were aware of an area of extreme precipitation 20 nm (37 km) ahead — that is, to the west. The first officer replied that the onboard radar was "painting it," and he asked for a report on the height of the cloud bases.

"The controller responded that he did not know what the cloud bases were but did know that the cloud tops were 'quite high,'" the report said. "The controller added, 'I don't recommend you go through it. I've had nobody go through it.' The controller then suggested, and the first officer accepted, a right turn to fly north about 60 nm (111 km) to avoid the severe weather.

While making the turn, the captain commented, "Let's hope we get underneath it."

At 0927, the controller asked the crew to state their intentions, adding, "I can't even give you a good recommendation right now."

The captain replied, "I've got it clear probably for another 40 miles." The controller then issued descent clearances, first to 19,000 ft, then to 14,000 ft.

The cockpit voice recorder (CVR) captured sounds consistent with rain striking the windshield about the same time the captain commented that it was fortunate that he did not promise the passengers a smooth ride. The first officer said, "Doesn't it figure [that weather] pops up right when we get here?"

The captain pulled the 'AIR BRAKE' handle all the way back, to engage the lift-dump system, nine seconds after touchdown.

© Chris Sorensen Photography

Hawker 800A

© Chris Sorensen Photography

The line of business jets collectively known as Hawkers began with the DH-125, introduced by de Havilland Aircraft in 1962. The airplane, very briefly named the Jet Dragon, had Bristol Siddeley Viper turbojet engines and seating for six passengers.

Through corporate acquisitions and reorganizations over the years, design and production passed from de Havilland to Hawker Siddeley Aviation, British Aerospace, Raytheon and Hawker Beechcraft. Throughout most of the airplane's life, the suffix A was used to designate models designed for sale in North America, and the suffix B to designate models destined for markets in the rest of the world.

The DH/HS/BAe 125 series has undergone continuous improvement, chiefly with more powerful and efficient engines, increased fuel capacity, a fuselage stretch to enlarge the cabin and aerodynamic refinements. Of particular note are the Garrett AiResearch (now Honeywell) TFE731 engines that debuted with the 125-700 model in 1976 and the curved windshield that appeared with the 125-800 in 1983.

The 800 model can seat up to 14 passengers, although an 8-seat cabin is typical for business operations, and has electronic flight instruments. The TFE731-5R-1H engines are rated at 19.13 kN (4,302 lb) thrust. Maximum weights are 12,430 kg (27,403 lb) for takeoff and 10,590 kg (23,347 lb) for landing. Stall speed in landing configuration and at a typical landing weight is 92 kt. Maximum rate of climb at sea level is 3,100 fpm, and maximum speed is 0.87 Mach. Range with maximum payload is 2,870 nm (5,315 km).

Hawker Beechcraft replaced the series designations with the name "Hawker" and added the Beechjet (nee Mitsubishi Diamond) and the Premier very light jet to the family as the Hawker 400 and 200, respectively. The company continues to produce the Hawker 750, 800, 850, 900 and 4000.

More than 1,370 Hawkers were manufactured from 1962 through 2006.

Sources: *Jane's All the World's Aircraft* and *The Encyclopedia of Civil Aircraft*

'The Sooner … the Better'

The flight was handed off to an approach control facility at 0932, and the crew was instructed to turn left to a heading of 250 degrees. After another hand-off a few minutes later, the crew was cleared to descend to 7,000 ft and was issued vectors for the instrument landing system (ILS) approach to Runway 30.

At 0935, the captain called for the "Approach" checklist. "Let's do the approaches real quick," he said. The pilots completed some checklist items using the challenge-and-response method, and the first officer called for an approach briefing. The captain responded, "It's going to be the ILS to three zero."

The approach controller cleared the crew to descend to 3,000 ft and provided the latest weather information for the airport, noting that it was 20 minutes old. The winds were from 320 degrees at 8 kt, visibility 10 mi (16 km) or more with thunderstorms, scattered clouds at 3,700 ft, a 5,000-ft overcast and distant lightning in all quadrants. The controller also said that there was light precipitation between the airplane and the airport, and that there were "a couple of heavy storm cells" about 5 mi (8 km) north and northeast of the airport.

The first officer acknowledged the controller's transmission and then said to the captain, "The sooner you get us there, the better."

The report said that this comment and others recorded by the CVR indicated that the pilots were "impatient to land … although no apparent reason existed for [them] to feel rushed." The crew was not prepared for the landing and a possible go-around, the report said. They had not completed the "Descent" and "Approach" checklists, conducted a thorough approach briefing or noticed indications that the wind had shifted to a tail wind.

At 0941, the captain called out, "Loc's alive," indicating that the airplane was intercepting the ILS localizer course. He then told the first officer, who had made several unsuccessful attempts to establish radio contact with the fixed base operator (FBO) at the airport, to try to contact the FBO again.

"The captain, as PIC, should not have allowed the first officer to make nonessential calls to the FBO during such a high-workload period," the report said, also noting that it was a violation of the "sterile cockpit rule" and caused the first officer to "fall behind on conducting his duties."[2]

The captain told the approach controller that he had the airport in sight and canceled the instrument flight rules flight plan. He extended the landing gear and verbalized several "Before Landing" checklist items while the first officer spoke with an FBO employee. The airplane was two minutes from touchdown when the pilots spent several seconds discussing the FBO's passenger accommodations and refueling procedures. The captain then told the first officer, "Why don't you go through the 'before landings.' Make sure you got it all."

'We're Not Dumped'

Shortly after an automatic callout indicated that the airplane was at a radio altitude of 300 ft, the captain announced that he was slowing to the reference landing speed (V_{REF}). The CVR recorded sounds consistent with touchdown at 0945:04 and extension of the air brakes 2.5 seconds later. The airplane did not have thrust reversers.

The first officer said, "We're dumped." This callout likely was a habitual reaction to seeing the captain move the air brake handle. However, the captain had moved the handle back to the "OPEN" position, not all the way back to the "DUMP" position, which greatly increases aerodynamic drag by causing the upper and lower air brakes to extend from 30 degrees and 56 degrees, respectively, to 51 degrees and 75 degrees, and the flaps to extend from 45 degrees, the maximum setting for approach, to 75 degrees.

Seeing an indication that the lift-dump system had not been engaged, the first officer corrected himself by saying, "We're not dumped."

The captain confirmed, "No, we're not." The CVR then recorded the sound of the air brake handle being moved to the "DUMP" position.

The captain initiated a go-around 10 seconds later, at 0945:20, when the CVR recorded the sounds of the air brake handle moving to the "SHUT" position, the captain calling for "flaps" and increasing thrust. Although the correct flap setting for a go-around was 15 degrees, the Hawker's flaps were retracted fully.

At 0945:27, the captain said, "Here we go … not flying … not flying."

The Hawker ran off the end of the runway two seconds later, lifted off the ground after rolling about 978 ft (298 m), struck a localizer antenna support structure and came to rest in a cornfield about 2,136 ft (651 m) from the threshold.

"The airplane was destroyed by impact forces and sustained a complete loss of survivable space for the flight crew and passengers," the report said. One passenger survived the impact but died two hours later.

Data Suggest No-Go

The Hawker did not have, and was not required to have, a flight data recorder. To recreate the approach and landing, investigators used data from the CVR, enhanced ground-proximity warning system, flight management system, air traffic control radar, witness statements, weather observations and the accident site.

The performance study indicated that the airplane had an 8-kt tail wind when it touched down at V_{REF} with a groundspeed of 130 kt about 1,128 ft (344 m) from the threshold of the wet runway, which was 5,500 ft (1,676 m) long and had a smooth (ungrooved) concrete surface.

There was no evidence of hydroplaning. "The airplane performance study indicated that, if the flight crew had continued applying sufficient braking effort [and had] not attempted to go around, the airplane likely would have overrun the runway at a groundspeed of between 23 and 37 kt and stopped between 100 and 300 ft [30 and 91 m] beyond the runway end but within the 1,000-ft runway safety area," the report said.

Initiation of the go-around 17 seconds after touchdown "left insufficient runway available to configure the airplane and accelerate to become airborne before reaching the runway end," the report said. "If the captain had conducted an approach briefing that included a committed-to-stop point — for example, in the case of the [Hawker], once lift dump has been deployed

Seeing an indication that the lift-dump system had not been engaged, the first officer corrected himself by saying, "We're not dumped."

— he may not have decided to attempt a go-around late in the landing roll."

Different Checklists

East Coast Jets' general operations manual did not include, and was not required to include, SOPs. Company pilots received training at SimCom. Training in SOPs was conducted according to the *SimCom Technical Manual*, which included "flow patterns, checklists, checklist discipline, PF [pilot flying] and PM [pilot monitoring] responsibilities, and challenges and standard callouts that the flight crew should make while conducting checklists," the report said.

During flight operations, however, the pilots used company checklists that were revised versions of the SimCom checklists. The report said that there were some differences between the checklists. For example, unlike the SimCom checklist, the company checklist designated the "Descent" checklist as a "silent checklist," to be called for by the PF and conducted silently by the PM. In addition, the company checklist did not include a call for a sterile cockpit below 10,000 ft.

There were signs that the performance of both pilots was affected by fatigue.

Another difference was that the company's "Approach" checklist did not include the various items specified by the training center for coverage during an approach briefing.

NTSB concluded that "having inconsistent checklists may create unnecessary confusion for pilots" and recommended that the FAA "ensure that pilots use the same checklists in operations that they used during training for normal, abnormal and emergency conditions."

Fighting Fatigue

The report said there were signs that the performance of both pilots was affected by fatigue, although they had not flown for several days and had been awake only about six hours before the accident occurred. "However, the accident trip involved an early reporting time, and evidence indicates that both pilots got less than their typical amount of sleep the night before the accident," the report said.

Including habitual afternoon naps, the captain typically slept about 11 to 15 hours a day. However, he had slept no more than five hours before the trip. The first officer had slept three hours less than his habitual nine hours. "Further, the investigation revealed that the first officer sometimes had trouble sleeping the night before a trip and that, on these occasions, he self-medicated with his fiancée's prescription sleep medication zolpidem [Ambien] because he did not have a prescription," the report said.

An interview with his fiancée and toxicological tests indicated that the first officer had taken zolpidem about 12 hours before the accident. Because the effects of the drug last only four or five hours, however, it is unlikely that it affected the first officer's performance during the flight, the report said, adding that "his use of the medication would not have negated the fatigue caused by his sleep debt and early awakening time."

The FAA allows the use of zolpidem no more than twice a week and no less than 24 hours before flight, while the U.S. Air Force and Navy require only six hours between use of the drug and flight.

"Allowing civil aviation pilots who have occasional insomnia to use prescription sleep medications that have been proven safe and effective would improve these pilots' sleep quality and operational abilities," the report said. NTSB has recommended that the FAA ease its restrictions on the use of zolpidem and "permit appropriate use of [other] sleep medications by pilots under medical supervision for insomnia."

This article is based on NTSB Accident Report NTSB/AAR-11/01, "Crash During Attempted Go-Around After Landing; East Coast Jets Flight 81; Hawker Beechcraft Corporation 125-800A, N818MV; Owatonna, Minnesota; July 31, 2008." The full report is available at <ntsb.gov/Publictn/A_Acc1.htm>.

Notes

1. The report acknowledged that the FAA adopted new regulations, effective in March 2011, requiring CRM training for Part 135 air taxi and commuter pilots and flight attendants.
2. FARs Part 135.100, the "sterile cockpit rule," requires, in part, that pilots refrain from nonessential conversation and radio calls during flight below 10,000 ft.

SAFETY CHILL

BY BARRY WISZNIOWSKI

Journalists are rightly concerned about "libel chill," the threat of litigation used to discourage investigative reporting that can damage powerful interests. Though underreported by journalists, there is another "chill" that is every bit as dangerous to the public interest.

I'm referring to "safety chill," the fear of legal liability, which is threatening to choke off the free flow of information through the aviation safety system that protects the traveling public.

There is no doubt that confidential reporting and collaborative investigations have led to dramatic improvements in aviation safety, with no fatal accidents reported in North American commercial aviation since the Colgan Air Bombardier Q400 crash near Buffalo, New York, U.S., in February 2009.

However, courts and administrative tribunals are increasingly threatening this system, putting the interests of litigants in our adversarial legal system ahead of any privilege or confidentiality attached to communications within the air safety reporting regime.

Airlines and pilots regularly and voluntarily provide details on hundreds of potentially hazardous incidents, based on the understanding that investigators and regulators will keep this information confidential and it will never be used against the reporters.

Without such safeguards, trust among pilots and other participants could disappear, destroying the flow of information that powers the aviation safety system. Making confidential information public could "chill" voluntary reporting.

This concern has recently led to conflict between the U.S. Federal Aviation Administration (FAA) and the U.S. National Transportation Safety Board, which sought access to FAA safety data. This information on safety incidents has been reported by airlines voluntarily with the understanding that it would be kept confidential. The FAA is rightly concerned that such voluntary reports would quickly dry up if airlines lose confidence in the integrity of the safety system, depriving everyone of valuable information.

Confidentiality is an integral part of Air Canada's Safety Reporting Policy, which governs the relationship between the airline and its pilots. However, this policy states that confidentiality cannot be maintained if it conflicts with law or an order from a court or administrative tribunal.

Numerous courts over the past several years have concluded that protections in safety reporting programs or investigation protocols cannot be sustained if "the likely result is injustice, whether to plaintiff or defendant," according to one such court decision.

In 2006, Canada's Federal Court of Appeal ruled that on-board recordings and transcripts of communications between pilots and air traffic controllers can be disclosed if "the public interest in the proper administration of justice outweighs the importance of the privilege attached to the on-board recording."

The judgment went on to state that a court could "require any person to give evidence that relates to the on-board recording." This was borne out by a British Columbia court in 2008, which compelled a Transportation Safety Board investigator to testify in civil litigation arising from a helicopter accident.

More recently, an Ontario court in 2009 ordered disclosure of a cockpit voice recording and transcription in civil litigation between Air France and the Greater Toronto Airports Authority, finding that a full hearing between litigants trumped any privilege attached to the recording.

The bottom line in Canada is that safety information can be used in any legal proceeding, if a court decides that the public interest in "the proper administration of justice" outweighs the protections of confidentiality extended to obtain sensitive aviation information.

This power to compel the release of confidential safety information also extends to players in Canada's workplace health and safety system, who have begun to access aviation safety reports (ASRs) submitted by pilots. These ASRs are used by pilots to flag issues and incidents incurred while on duty, so that individual safety issues can be addressed and any worrisome trends identified. Pilots have always been generous in contributing ASRs, assuming that any information contained in them would remain confidential.

However, recent decisions and actions have demonstrated that joint health and safety workplace committees, health and safety officers, appeals officers and the Canada Industrial Relations Board can see and use ASRs without pilots' consent, by virtue of the powers granted to them under the Canada Labour Code.

These health and safety officials are entitled to ask for "any information that the committee or representative considers necessary to identify existing or potential hazards with respect to materials, processes, equipment or activities" under the Code.

They are also entitled to "full access to all of the government and employer reports, studies and tests relating to the health and safety of employees in the workplace." The Federal Court ruled in 2010 that an ASR was an "employer report" and ordered it supplied to a workplace health and safety committee.

This is a worrisome trend. If pilots and other participants in the aviation safety system lose confidence in such protections, the information that is the lifeblood of that system will simply disappear.

In Canada, we need legislation to provide confidentiality protections within the aviation safety system. At a minimum, the law should be changed so that confidential safety information is disclosed as a last resort, if it is the only way to achieve justice. The burden of proof should be placed on the party seeking to disclose the protected information, with such release taking place under strict limitations. Our federal government, which recently set aside consideration of amendments to the Aeronautics Act, should put this matter back on its legislative agenda.

In the interest of public safety, we must take action to ensure that "safety chill" doesn't become a total freeze.

Capt. Barry Wiszniowski is chairman, Flight Safety Division, Air Canada Pilots Association.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to J.A. Donoghue, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA or donoghue@flightsafety.org.

Collective Wisdom

Simulations show how child restraint systems work, but lack of injury-exposure data impedes policy insights.

BY WAYNE ROSENKRANS

Campaigners for and against rules requiring child restraint systems (CRSs) for U.S. airline passengers under age 2 generally were unyielding when they recently reiterated their long-held positions. Both camps agreed, however, that as long as the youngest passengers travel under this 58-year-old exception to seat belt rules, airlines should promote voluntary use of CRSs approved by the U.S. Federal Aviation Administration (FAA) and work hard to accommodate them.

For a few of these participants, another point of agreement during the U.S. National Transportation Safety Board (NTSB) Child Passenger Safety Forum in December 2010 was the recognition that — despite safety management systems becoming the norm in civil aviation — there has been minimal collection and analysis of CRS usage-versus-injury data from line operations. Now, growing use of aviation CRSs and near-term prospects for superior designs might help justify new studies to better gauge effectiveness of this injury mitigation, they said.

The NTSB's long interest in eliminating the lap-child exception has been reflected in 14 related safety recommendations, Chairman Deborah Hersman said. As of 2011, NTSB policy makers have yet to be convinced that voluntary CRS use by passengers is sufficient. "Education is not enough because education is not going to reach everyone," Hersman said. "[Parents/guardians] have to have requirements, laws or specific standards to help them to make the right decision."

Under the current regulation, airline Web sites should reflect in every possible manner the government–industry encouragement of passengers to use a CRS, and should remove any disincentives for them, she said. Hersman believes, for example, that options to purchase a seat specifically to accommodate a CRS should be as clear to airline Web site users as any other ticket-purchase option. Ideally, Web sites consistently should query users about any children under 2 who would be traveling, proactively inform ticket buyers of all their CRS-related options and recommend using a CRS to optimize child safety.

In 2009, approximately 6.3 million passengers under age 2 were enplaned by U.S. regional and major air carriers, said Nancy Lauck Claussen, aviation safety inspector, Air Transportation Division, FAA Flight Standards Service. The FAA has collected no data about the percentages of those passengers with children under 2 who travel with and without a CRS, she said. The agency cited fatal accident data and several studies that forecast how transportation-mode choices of U.S. airline passengers would change if the FAA eliminated the lap-child exception.

"If we look back over the last 32 years, there were three accidents where the fatality of a child under 2 would have been prevented if that child had been in a CRS; there have been none in [the last] 14 years," Claussen said. The FAA has concluded from a series of independent studies since the 1990s that changing FAA regulations to require the purchase of an extra airplane seat to accommodate a mandatory CRS for children under 2 would have "the unintended consequence of an increase in transportation deaths," she said. The agency has estimated that the life of one child under 2 would be saved in 10 years if this regulatory change were made. The predicted negative consequence in that period, however, would be that more parents and guardians would choose to travel via highways rather than buy an additional airline ticket and provide a CRS, with at least 60 deaths of children under 2 on highways attributable to the disparity of risk of travel by motor vehicle versus airline.

America's exclusion of infants from seat belt requirements dates from 1953, said John Meenan, executive vice president and chief operating officer of the Air Transport Association of America (ATA). "Airlines [today] strongly encourage passengers to travel with the restraint devices that they use in their automobiles," he said, adding that the public understands CRSs to a much greater extent than even five years ago but "there's always room for more education."

The ATA believes the "vast majority" of U.S. parents/guardians traveling with a child under 2 currently bring to the aircraft the same CRS used in their motor vehicle, typically devices also certified for aviation use.

Meenan told the NTSB that he is unaware of any data compiled by the ATA, a member airline or another source on numbers of children under age 2 flying on a parent/guardian's lap versus in a CRS. "At the time the flight manifest is created, of course, that information is recorded and maintained, but these data are not kept on any long-term basis, so no one that I'm aware of is tracking those numbers specifically," he said. Recently, the U.S. Transportation Security Administration began compiling the names and birth dates of every air traveler, perhaps indirectly creating a resource for child safety specialists, he added.

Dennis Durbin, a pediatric emergency physician, clinical epidemiologist and professor of pediatrics at the Children's Hospital of Philadelphia and the University of Pennsylvania School of Medicine, finds rigorous science lacking from aviation CRS debates. "[American Academy of Pediatrics] experience in child passenger safety, particularly over the past 10 years, … illustrates the critical importance of having [good quality, child-specific] data to infuse into the conversation," Durbin said. "I think there's a notable lack of that, specifically when it comes to children's safety on commercial aircraft."

Physics of Injury

The FAA recommends that all passengers under age 4 be restrained in an appropriately sized CRS, but does not recommend an age to wear a seat belt without a CRS. This reflects knowledge of the effectiveness and limitations of current CRSs generated by researchers at the FAA Civil Aerospace Medical Institute (CAMI) and in other countries.

"Children of any age are permitted to occupy a passenger seat and be secured with just the lap belt [on U.S. air carriers]," said Richard DeWeese, coordinator of CAMI's Biodynamics Research Team. "Use of the lap belt can provide restraint during turbulence." In a crash scenario, however, "essentially, children need to have upper torso restraint to prevent contact with the [rigid frame under the front of their seat] or potentially experience spinal cord injuries due to the whipping-forward effect," he said.

CAMI researchers frame the problem as standard aircraft seating options for children not providing the highest level of safety possible. "While holding a child under 2 on the lap is allowed, there's a risk for serious injury in the unlikely event of severe air turbulence or a crash landing," DeWeese said. "This is because the person holding the child cannot react fast enough to counter an unanticipated and suddenly applied load, as occurs during turbulence. They also just don't have enough strength to hold onto a child during extreme loading conditions that can occur during a crash landing."

Simulations with anthropomorphic test devices (child-size dummies configured with sensors) of aircraft impact with significant forward deceleration show how an unrestrained, lap-held child slides straight forward, forcefully striking the seat back. "The adult folds forward onto the child, potentially crushing [the child]," DeWeese said. The probability would be high that the child would be ejected from the

Examples of U.S. Child Restraint System Practices

Safety Objective	Practical Application of Rules and Guidance
Keeping aviation-only CRSs out of motor vehicles	In September 2010, the FAA addressed driver/passenger/aircraft crew confusion by coining the term *aviation child safety devices (ACSDs)* to distinguish — and clearly label in coordination with the NHTSA — the subset of CRSs that are designed solely to meet aviation performance standards and are approved only for use in aircraft.
Prohibiting non-approved CRSs for ground movement, takeoff and landing	U.S. airline policies may prohibit use of non-approved CRSs. The applicable FARs require that CRSs approved for use in these flight phases be so labeled/marked. During the cruise portion of the flight, there is no regulatory prohibition regarding the use of any type of child restraint, including those prohibited from use during ground movement, takeoff and landing.
Maximizing CRS safety in aircraft	Safety factors for use of an approved and properly labeled/marked CRS include a parent/guardian accompanying the child, CRS properly secured to the seat and oriented forward or backward per label instructions in a forward-facing aircraft seat, the cabin crew check that the child is properly secured, the parent/guardian checking that the child does not exceed the weight limits for the CRS, and preferred CRS placement in a window seat so as not to block access to the aisle by the parent/guardian or other passengers during an emergency evacuation.
Prohibiting some CRSs even if approved by non-U.S. authorities	The FARs specify that "no aircraft operator may permit a child to occupy a booster-type, vest-type, harness-type or lap-held CRS during takeoff, landing and movement on the surface, except when the CRS has been approved by the FAA … Booster-type, vest-type and harness-type CRSs approved by the FAA … may be used during all phases of flight."

CRS = child restraint system; FAA = U.S. Federal Aviation Administration; FARs = U.S. Federal Aviation Regulations; NHTSA = U.S. National Highway Traffic Safety Administration

Notes: The source of standards/basis of approval for ACSDs is either FAA Technical Standard Order C-100b, "Child Restraint System," or FARs 21.305(d), "Production and Airworthiness Approvals, Part Marking, and Miscellaneous Amendments."

Source: FAA Advisory Circular 120-87B, "Use of Child Restraint Systems on Aircraft"

Table 1

parent's grasp and the seat area "in an actual crash, where the aircraft would be bouncing or yawed." The CAMI CRS research focus has been on devices that accommodate a child up to approximately 40 lb (18 kg) using protective shells that have an internal harness.

One typical FAA-approved CRS, the aft-facing infant-carrier type, restrains the child within a protective shell. Another type, the forward-facing carrier, limits the child's forward excursion and head injury risk using belts or support surfaces attached to its protective shell.

Using the FAA's separate supplemental type certificate process for assessing equivalent level of safety, the agency in 2006 approved the non-shell AmSafe Aviation CARES device, which adds upper torso restraints to the existing lap belt.

Working with SAE International to overcome poor interfaces between multi-purpose CRSs and aircraft, the FAA last year issued an aerospace technical standard order (TSO) for "aviation child safety devices" (Table 1) capable of providing a "very high level of safety" compared to current devices, DeWeese said, adding, "So far though, this standard has proven to be technically challenging to meet and, while there are some models under development, none has actually been issued a TSO yet."

Overseas Innovation

U.S. airlines, cabin crews and passengers have become familiar with CRSs to an unprecedented extent, the airline industry says. "Our experience is that the vast majority of [current CRSs] do fit in the vast majority of seats aboard aircraft," said the ATA's Meenan. "Occasionally, we may find a situation where that's not the case, and that passenger is then reaccommodated with a different seat."

The NTSB also invited a non-U.S. airline to the forum to summarize its CRS practices, experience and data. From January 2005–October 2010, Virgin Atlantic Airways annually carried approximately 4.5 million to 6 million passengers. "Of these, an average of 7.5 percent were children [that is, 337,500 to 450,000 between 2 and 12 years old] and 1 percent were infants [45,000 to 60,000 under 2 years old]," said Mary Gooding, cabin safety manager at the company.

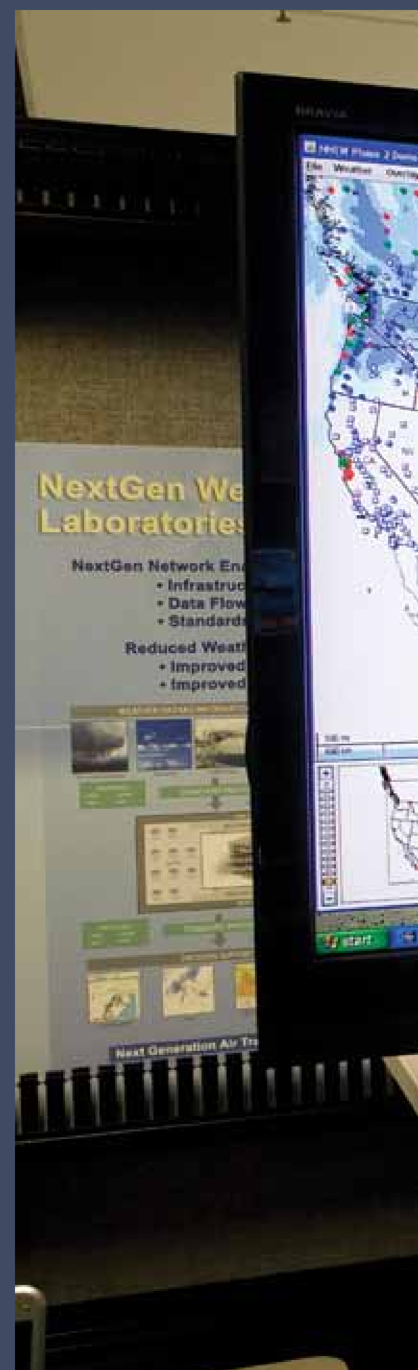
In March 2008, the airline introduced its own newly designed, U.K. Civil Aviation Authority–approved CRS for infants between 0 and 6 months; the airline recommends that they be reserved with a discounted aircraft seat during travel booking but provides the device at no cost to passengers, even while boarding if possible. The devices are installed by flight attendants.

KORD 201721Z 2018/2124 29012G18KT P6SM B
FM202200 29010KT P6SM BKN040
FM210000 29008KT P6SM SCT040
FM210600 VRB03KT 5SM BR SCT005
FM211500 08005KT P6SM BKN200
FM212000 10010KT P6SM BKN080 BKN20

Why Good Forecasts Go Bad

Every now and then even the best tools result in little more than a guess.

BY ED BROTAK



Accurate weather forecasts are crucial to the aviation industry. The greatest concern is, of course, the safety of flight crews, passengers and the aircraft they are in. The economic implications are also enormous. Knowing weather conditions at the departure and arrival locations and along the flight route is critical to an industry in which, literally, time is money. From the meteorological point of view, the needs of the aviation community have often driven advances in weather forecasting for everybody.

Aviation interests are mainly concerned with forecasts for the next day or so, the realm of the terminal aerodrome forecasts (TAFs). In terms of standard forecasting, this is considered a short-range forecast. Also, there are more weather elements of concern to pilots than those in the forecasts produced for the general population. A standard public forecast includes sky condition, precipitation, temperatures, and wind. TAFs include wind and precipitation forecasts, but also visibility and specific cloud and/or ceiling heights, and they have much greater detail.

Overall, aviation weather forecasts are very accurate. The most recent statistics for the United States show that critical instrument flight rules (IFR) conditions are correctly forecast 64 percent of the time, with a false alarm rate of 36 percent. But the old meteorologist's adage is: "The forecasts you miss are the ones they remember."

To understand why some forecasts are incorrect, we must examine how weather forecasts are made.

To forecast tomorrow's weather, we must know the state of the atmosphere now. The better we can depict the current weather, the more accurate the forecast will be. Surface observations of temperature, humidity, winds, pressure, current weather, etc., are taken at thousands of stations around the world. Some observations are done by automated sensors, others are done by people. Surface aviation observations

KN020 OVC035

0

— meteorological terminal aviation routine weather reports (METARs) — are taken at least every hour and more frequently — in the form of special reports (SPECIs) — if dictated by adverse or changing weather conditions. The official meteorological surface observations are taken every three hours at designated government stations. Upper-level observations are done twice a day from far fewer sites.

Balloon-borne instrument packs, or radiosondes, send back information about temperature, humidity and pressure at different heights in the atmosphere. In addition, tracking of the radiosondes provides data on wind direction and speed at various levels. Data from weather radar have been available since the 1950s. The first weather satellite was launched in 1960. Today we have many weather satellites providing

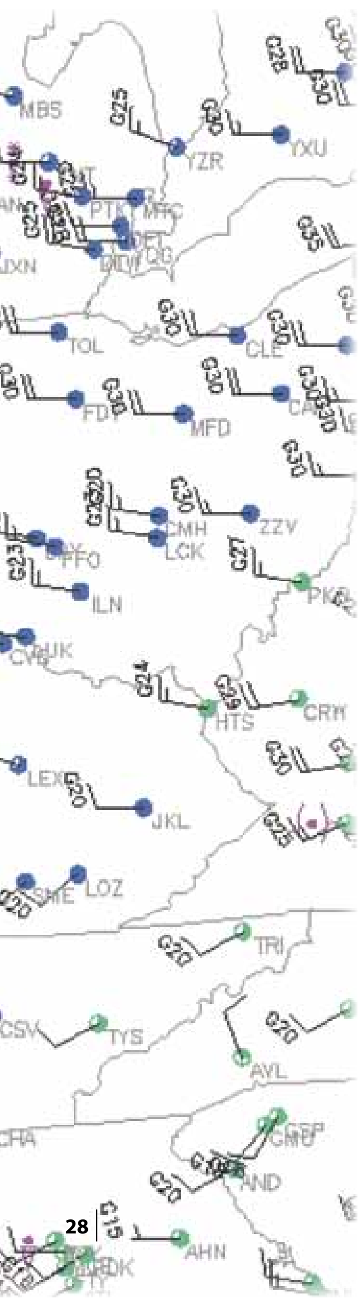
© Chris Sorensen Photography

an abundance of data, especially at upper levels and in remote regions of the world.

The forecast tools or methods used by meteorologists vary with the time period being forecast. With forecasts going out to six hours in the future, the time period critical for many aviation purposes, meteorologists rely heavily on current observational data derived from official site observations, satellites and, when precipitation is involved, radar.

When weather systems are moving, continuity forecasts indicate when clouds and/or precipitation will move into or out of an area.

If there is little weather system movement, a simple *persistence* forecast may suffice. If a terminal is socked in with fog, most likely that location will have fog in the next hour, too. Often, when weather systems are moving, *continuity* forecasts indicate when clouds and/or precipitation will move into or out of an area. Clouds are tracked by satellite to determine speed and direction of movement.



Weather radar can provide the same information for precipitation. A simple continuity forecast just assumes the clouds or precipitation will continue to move at the same speed and in the same direction. The most difficult situation for forecasting clouds and/or precipitation via the continuity method is one in which clouds or precipitation form at a location rather than being advected — that is, being transported by the wind. Although not the norm, this does happen, particularly where there are orographic effects, or air flow disturbed by topographic features.

For forecasts beyond six hours, meteorologists rely heavily on numerical and statistical models. Numerical weather prediction has been viable since 1960. Prior to that, weather forecasting was more "seat of the pants," with meteorologists collecting as much data about the current situation as possible and making forecasts using their own experience, knowledge and intuition. Meteorologists theorized that the atmosphere must obey the basic laws of physics. By stating these laws as mathematical equations, real observations from the atmosphere could be used to generate a mathematical model of the atmosphere. By using time derivatives, the equations could be solved for future times, thus giving weather forecasts.

However, the inability to do all the calculations required, especially in a timely manner, made numerical weather prediction just a dream until the development of computers beginning in the 1940s. These ultimate number crunchers were exactly what were needed to make the dream a reality. By 1960, some computer-generated forecasts became superior to anything that could be done by hand. In time, numerical weather prediction would become the norm, with the meteorologist's role relegated to "tweaking" the computer guidance to allow for variations that could not be incorporated in the models.

Even though the numerical models improved with time, they were still limited in what weather elements they could actually forecast. They were very good at producing a picture of what various layers of the atmosphere would look like in the future, but they weren't designed to predict the parameters, especially at the surface, that both the general public and the aviation community needed — elements like temperature, chances of precipitation and visibility. Realizing these model shortcomings, meteorologists turned to statistics.

By using regression analysis — establishing a relationship between variables to allow the prediction of one variable based on changes in the other — meteorologists could now relate elements not predicted by the models to ones that were.

For example, numerical models do not predict the chance of rain or snow, the probability of precipitation (PoP). But the models do forecast the amounts of moisture at the standard cloud level of 10,000 ft. One can then statistically relate the amount of moisture at this level to the occurrence in the past of precipitation at the surface. In that way, computer-generated forecasts of cloud level moisture could be used to forecast the PoP. Statistical relationships can be made with any variable as long as there is a physical cause and effect. In other words, computers could now forecast anything. These forecasts were called MOS — model output statistics — developed in the late 1970s and a staple of today's weather forecasts.

In simple terms, MOS is just a memory system. The computer "remembers" past weather situations. It is an analog forecaster — it relates a situation it sees now to situations it has seen in the past. It assumes a similar situation will produce similar sensible weather. Interestingly, many "intuitive" meteorologists do the same thing in making a forecast. They may not even realize that they are subconsciously remembering past analog situations while making the current forecast.

But, like any statistical forecasting scheme, MOS has its limitations. The forecast is only as good as the relationship between the predicted element and the predictor. There are no perfect relationships in meteorology, no correlation coefficients of 1. For example, a particular moisture value at 10,000 ft doesn't always correspond with the same PoP. There are a range of values possible, with the distribution of possible variables usually being normal — that is, following the classic bell-shaped curve. In our example, the forecast PoP produced by MOS is the most likely outcome, but there are no guarantees. Like any statistical technique, the more original data you have to make the relationship, the better the forecast.

There are a variety of potential error sources for MOS forecasts. If the numerical model that creates the basic forecast is incorrect, then the MOS it produces will also be inaccurate. Unusual or rare weather events will not be forecast well since there are very few analog situations to establish the statistical relationships. In reality, the relationship between two variables can change depending on the time of year. The statistical equations used are modified several times a year, but not often enough to catch all the changes.

Overall, there are a few basic things that can be said about weather forecast accuracy. In general, short-range forecasts are more than 90 percent accurate. It is easier to forecast good weather than bad weather. Fortunately, for most locations, fair weather — visual flight rules conditions — is more common. High pressure areas which usually bring fair weather tend to be larger and are handled well by the numerical models. Situations which bring clouds and precipitation tend to be dominated by smaller-scale weather features which are difficult for the computer models to predict.

There are a number of other reasons why weather forecasts can go wrong. As stated before, to forecast the future weather, we must know the current state of the atmosphere. Anything we miss can come up and bite us later. Only North America and Europe have enough weather-reporting stations to give an accurate depiction of current weather. Much of the less developed regions of the world and the vast ocean areas are underreported.

One of the original problems with numerical weather forecasting remains today: the time constraint. Forecasts still have to be produced in a timely fashion. Compromises have to be made in the numerical models so they can be run quickly by the computer. Whether it's in the size of the region covered, the span of the time steps used in the calculations or changes in the basic physics of the model itself, any and all of these can influence forecast accuracy.

Some of the problems with weather forecasts stem from the fact that, frankly, we don't fully understand everything that goes on in the atmosphere. There is a wide variety of factors that influence the weather. Taken individually, most of these are straightforward cause and effect. But, in the real world, a wide variety of forces are in play at the same time. It is difficult and sometimes impossible to judge which factors will be dominant, or which factors will cancel each other out. Added to this are the myriad interactions possible. This is not like performing experiments in a lab under controlled conditions. The atmosphere is our lab, and anything goes.

And for weather forecasting, as well as most other things, we have to allow for the implications of unforeseen events. This is captured in the "chaos theory." In the early 1960s, pioneering meteorologist Edward Lorenz applied the chaos theory to weather. Poetically, he described how a butterfly flapping its wings could set up air currents that, under the right conditions, could alter the weather many miles away. And, as we all know, you can't forecast butterflies.

Unusual or rare weather events will not be forecast well since there are very few analog situations to establish the statistical relationships.

Aviation forecasts are inherently more difficult to prepare than standard public forecasts. They have to be much more precise. In terms of time periods, standard forecasts for the public work in 12-hour increments with general references to events. "Increasing cloudiness during the day with a chance of rain by the afternoon" would be a typical forecast. Aviation forecasts often need to be broken down by the hour when conditions warrant. And pilots need to know about specific cloud heights and visibilities, elements which are, by nature, very difficult to forecast. Also, public forecasts cover a wide area. TAFs are for particular sites.

Dan Miller and Jonathan Lamb, two of my former students, have years of experience as meteorologists, much of it as aviation forecasters, with the U.S. National Weather Service. They break down the standard aviation forecast into three time periods. For the first six hours, persistence and continuity are the main forecast tools.

Regarding the six-hour forecast, Lamb said, "Sometimes the best forecast tool is to put the [computer's] distance/speed tracker on the leading edge of clouds or an area of rain." Miller said, "We concentrate most of our effort in the short term when it matters the most and when confidence can be higher."

For forecasts of weather 12 to 36 hours in the future, numerical guidance is routinely used. Here, the forecaster's local knowledge and skill can improve upon the raw computer-generated forecast. However, both Miller and Lamb noted that the intermediate time frame, 6 to 12 hours, can be challenging to forecast. It's too far out to rely on persistence or continuity, and the standard mathematical models aren't designed for this either.

In weather and forecasting, time and size are related. Near-term weather conditions are dominated by smaller-scale weather systems. These are not handled well by the standard models. The models were designed for larger-scale systems, those measured in hundreds of miles. But Lamb says help may be on the way for forecasters in the United States. After a number of years of trial and refinement, the high resolution rapid refresh (HRRR) model will become fully operational later this year. With an interior grid of 3 km (2 mi) length and a one hour update cycle, the HRRR should provide numerical guidance that has been lacking for the intermediate time frame so critical for aviation.

The way forecast material is presented is also changing. Rather than standard text, more of the forecast information is now displayed graphically. This trend will likely continue.

Lamb and Miller say that one of their greatest challenges in aviation forecasting is dealing with summer thunderstorms. "It was common for us to predominately [forecast] TSRA (thunderstorms with rain), or include it in 'tempo' groups [forecasts of temporary or possible events] for long periods of time in the late afternoon and evening in the warm season when we were expecting scattered diurnal pulse thunderstorms," Miller said. "It turned out we were way over-forecasting the occurrence of TSRA at the airports."

At Lamb's office, the aviation industry made its feelings clear. "We've heard over and over again that we should not blanket TSRA in TAFs unless confidence is high, because it requires fuel for alternates and gets very expensive for the airlines." Lamb said that, now, "we don't include thunderstorms in the TAF until [1200 universal coordinated time (UTC)] at the earliest and usually with the [1800 UTC] issuance when we see where stuff is developing and where the cumulus field is better developed." But on the downside, he said, "Since thunderstorms have such a high impact on aviation users, it stinks not being able to give much of a heads-up." It's similar at Miller's office: "Now, we mention [thunderstorms] and [cumulonimbus] sparingly, especially in the later time periods. We include it when we have high confidence of it actually affecting the TAF sites, typically in the near term."

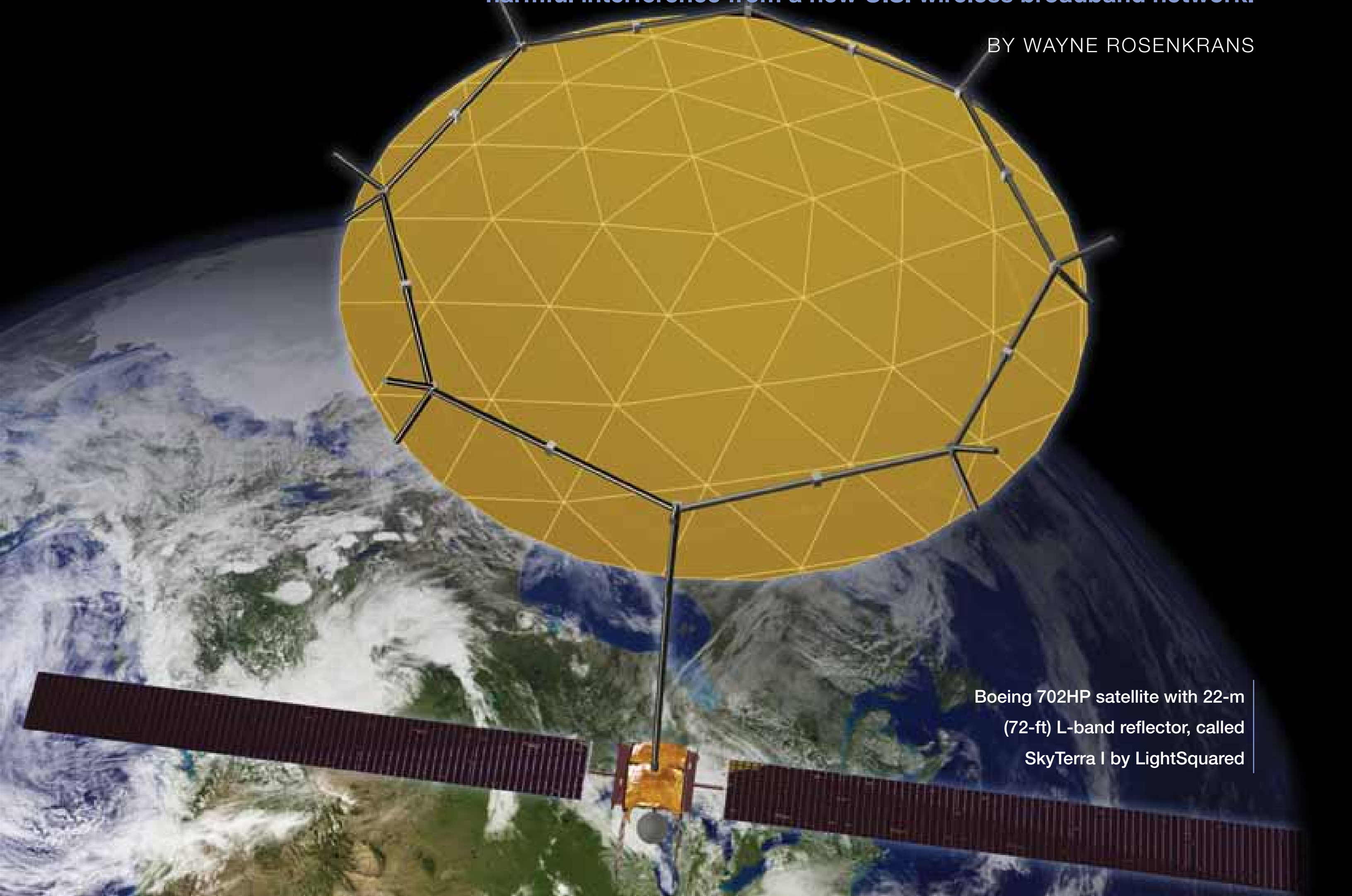
Both Lamb and Miller agree that local knowledge and experience are critical attributes of a good aviation forecaster. As for the problems, Miller sums it up this way: "Aviation forecasting tends to be quite difficult and tricky, and can be quite frustrating at times. There is still much room for improvement." Or, as Lamb put it: "Just this morning, I was pulling my hair out when doing the aviation forecast."

Edward Brotak, Ph.D., retired in 2007 after 25 years as a professor and program director in the Department of Atmospheric Sciences at the University of North Carolina, Asheville.

LightSquared on Track

GPS specialists race the clock to resolve concerns about harmful interference from a new U.S. wireless broadband network.

BY WAYNE ROSENKRANS



Boeing 702HP satellite with 22-m (72-ft) L-band reflector, called SkyTerra I by LightSquared

© Boeing Defense, Space & Security

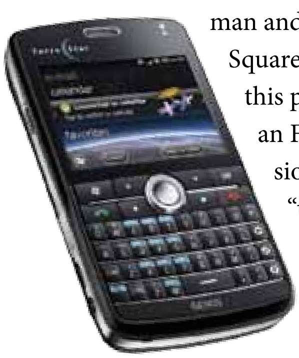
By June 15, U.S. aviation industry leaders, manufacturers of global positioning system (GPS) receivers,[1] a mobile satellite service (MSS) company and the federal government expect a joint work group's final report to break through a 5-month-old legal and technical impasse. The unresolved question is whether the wireless broadband network now being built by LightSquared Subsidiary[2] — the first of its kind to blend satellite-based mobile communication with terrestrial base stations sharing satellite frequencies — will cause any harmful interference to GPS receivers.

LightSquared has its new satellite ready for full operation in geostationary orbit and base stations under construction to launch this network, possibly within a few months, offering nationwide digital voice, video and data at broadband Internet speeds. Designed to be sold on a wholesale basis to partner companies, these services will accommodate smartphones, tablet computers and other portable devices. The system provides the option to users to communicate only via 40,000 cellular-like base stations while their mobile devices are in range, only via satellite while anywhere in the country, or both ways, with one mobile device and telephone number.

In LightSquared's MSS ancillary terrestrial component (ATC) design, its satellite operating in the L-band[3] can be configured with a large number of high-gain multiple-beam antenna patterns, with each beam providing coverage to a specific circular area on the ground. Beams on separate frequencies can overlap, or more than one satellite can transmit on the same frequency if there is sufficient geographic separation in the beams on the ground.

LightSquared has provided MSS since 1996 but never before offered terrestrial service using its MSS ATC authority. The company has committed to the U.S. Federal Communications Commission (FCC) to initially cover 100 percent of the U.S. population with its satellite and, in phases, at least 260 million people in the United States by the end of 2015 with LTE (long term evolution), the name of a fourth-generation (4G) radio technology for mobile telecommunications networks.

Only six months ago, company officials considered external concerns about their system's effect on GPS receivers important to acknowledge but basically outdated because of protections built into the design of the network, FCC public records show. But by the end of April, Sanjiv Ahuja, chairman and CEO of LightSquared, reframed this perspective to an FCC commissioner, saying that "the company's goal [is] to work for the coexistence of a new, competitive wireless network and a robust GPS system" during a meeting about progress toward implementing the new network and cooperation with the GPS industry.



The FCC — which on Jan. 26 granted authority to LightSquared to operate this network through a conditional waiver of one element of FCC rules — has the responsibility to decide how effectively GPS-related concerns have been addressed.

While the FCC conducts the current LightSquared proceeding in its role as regulator, it also leads implementation of the federal government's 10-year *National Broadband Plan* to reallocate many portions of the U.S. radio frequency spectrum long dedicated to MSS. A key goal is to create affordable Internet access nationwide through wireless broadband technology. As a regulator responsible for public safety, the FCC — with advice from the National Telecommunications and Information Administration (NTIA) — has noted since 2003 that emissions from MSS ATC would have to be "carefully controlled to avoid interference with GPS receivers."

The U.S. GPS Industry Council, a trade association working with the Air Transport Association of America (ATA) and other aviation organizations, worked to persuade the FCC to require further study of potential interference.

LightSquared expects to use its allocated MSS L-band frequencies for ATC base stations and for mobile devices. These MSS frequency bands "bracket" the band used for the L1 GPS signal. Many experts have urged caution, predicting a grave risk of overloading and/or desensitizing safety-critical receivers that turn GPS signals into useful positioning, navigation and timing data.

The L-band of the spectrum is one of only three MSS frequency bands also capable of supporting broadband service, said the FCC.[4] The portion of the L-band allocated to LightSquared comprises 1525–1559 MHz and 1626.5–1660.5 MHz. GPS receivers operate in the adjacent 1559–1610 MHz band (Figure 1).

One example of a system-level concern came from Lockheed Martin, which operates two regional positioning service satellites integral to the U.S. Federal Aviation Administration's (FAA's) wide area augmentation system (WAAS). On Feb. 25, the company urged the FCC to withhold all authority for LightSquared to begin operating MSS ATC service "until the FCC is able to determine that the new service can be provided compatibly with radio navigation satellite services in the L1 band and under what specific conditions."

Earth stations that uplink the signal to these satellites depend on an extremely sensitive GPS/WAAS receiver with a much higher-gain antenna than those common in aviation GPS receivers, said Jennifer Warren, vice president, technology policy and regulation, Lockheed Martin. "If signal reception is disrupted, these antennas will be unable to perform a safety-critical function to uplink the proper [WAAS] signal for broadcast from the regional positioning service satellites' L1 signals." This erroneous broadcast would not be detected immediately by normal methods but quickly would trigger a WAAS shutdown if there were no WAAS backup, she added.

Current Proceeding

The FCC's waiver conditions have shifted the adversarial interactions of this proceeding into a cooperative and constructive mode. This mode was facilitated by LightSquared's agreement to convene an expert technical team, called the LightSquared Work Group (Table 1, p. 34, and Table 2, p. 35), "to study fully the potential for overload interference/desensitization to GPS receivers, systems and networks."

LightSquared had considered its waiver request as "a minor modification to its license" to operate an MSS ATC network, said Jeffrey Carlisle, the company's vice president, regulatory affairs and public policy.

A series of interactions and agreements since 2001 with the GPS and aviation industries also persuaded LightSquared that mitigation of harmful interference to GPS receivers was a settled issue by 2010, he said. Moreover, plans for a wireless broadband network based on MSS ATC — including its scale and frequency re-use plan — had been widely known since 2003, yet further concerns were not raised by representatives of the GPS or aviation communities during other FCC proceedings between 2003 and late 2010, Carlisle added.

"No party objected [previously to FCC] approval of LightSquared's business plan either initially or on reconsideration," he recalled. In November 2010, he had said that "concerns raised by some parties regarding the coordination with GPS operations are irrelevant to this proceeding and should be resolved through collaborative processes among the interested parties that are already in place" in light of protective measures already required by the FCC.

The following month, Fred Campbell, president and CEO of the Wireless Communications Association International, said that many industry groups and the FCC were unprepared for the full implications and scope of the LightSquared network. "Until LightSquared's recent proposal, the deployment in the L-band of 40,000 terrestrial base stations using the LTE air interface was not contemplated by the [FCC]," Campbell said. Even the prior FCC decisions did not "expect an MSS ATC licensee to deploy 40 million mobile devices," he said.

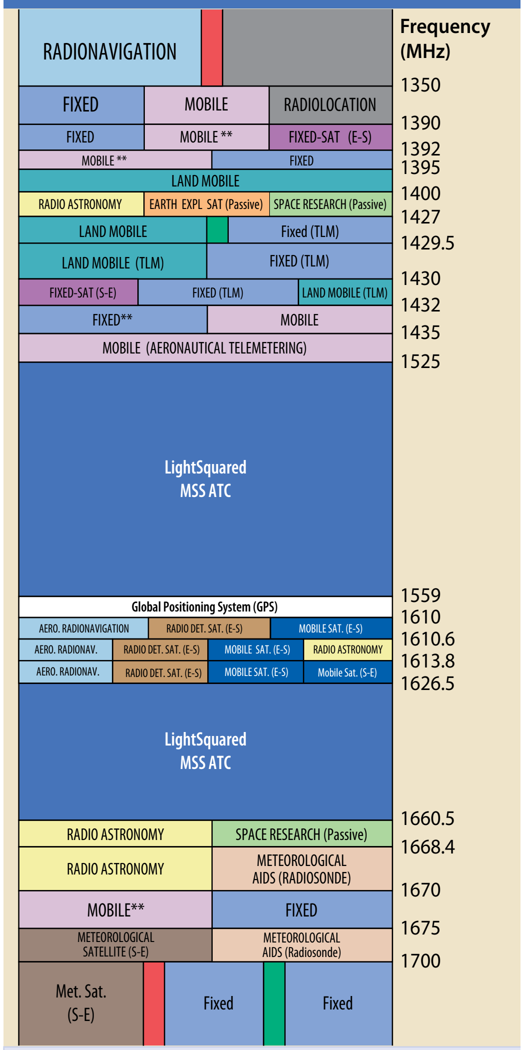
This year, Kris Hutchison, president of Aviation Spectrum Resources, a communications company serving the air transport industry, noted on March 29 that LightSquared may have misinterpreted the aviation and GPS industries' silence on MSS ATC between 2003 and 2010.

"Participation in proceedings that occurred years ago and addressed interference arising from a markedly different deployment scenario … does not resolve concerns that arise from the current interference environment between more sophisticated and extensive GPS and ancillary terrestrial component operations," Hutchison said.

For example, existing FCC regulations on MSS ATC — such as separating base stations from airport runways, taxiways, aprons and takeoff and landing flight paths by at least 190 m (623 ft) — originally resulted from concerns about interference to the satellite communication transceivers aboard aircraft, an issue raised in 2003 by The Boeing Co.

In explaining its conditions for the waiver, the FCC noted that in addition to concerns renewed by the private sector, the federal government's NTIA had submitted concerns about "the potential for adverse impact of mobile satellite service/ancillary terrestrial component operations in the L-band on GPS and other global navigation satellite system receivers."

LightSquared Neighborhood: Subset of U.S. Radio Frequency Allocations



ATC = ancillary terrestrial component; LightSquared = LightSquared Subsidiary; MSS = mobile satellite service

Note: Current spectrum allocations discussed in this article for LightSquared and GPS have been overlaid on a small fraction of the October 2003 *U.S. Frequency Allocation Chart,* available at <www.nti.doc.gov/osmhome/allochrt.html>. They show only relative position and are not to scale.

Source: U.S. National Telecommunications and Information Administration; U.S. Federal Communications Commission

Figure 1

Work Group Testing

Analysis of interference to GPS receivers involves consideration of factors such as the number of GPS satellites available, the received signal strength of the GPS signal, whether GPS receivers have an obstructed or clear view of the sky, LightSquared's terrestrial broadband signal strength, and distance of the GPS receiver from the terrestrial wireless broadband transmitter, either a base station tower or handset, according to the FCC.

The concept behind most testing is to provide an interfering set of simulated signals at the LightSquared downlink and uplink frequencies in the presence of a controlled set of simulated GPS L1 and L2 signals, with varying signal-power levels and varying numbers of satellites, including WAAS signals for some tests. Unlike earlier preliminary tests by individual companies, the emulated LightSquared signals are amplified and filtered using proprietary transmit filters provided by LightSquared.

To support this testing and analysis, LightSquared also has been providing technical details of its equipment, channelization plan, output power, out-of-band emission characteristics and emissions mask for its MSS ATC network.

The Work Group's April 15 report to the FCC details progress so far, and tables in this article focus on its Aviation Sub-Team, which is studying the risk of harmful interference to GPS receivers common in commercial aviation. Six other sub-teams also are conducting tests and analysis on other categories of GPS receivers.

"LightSquared plans in all three phases [of network deployment] to operate base stations at least 4 MHz away from the GPS band at 1559 MHz," the

Assessing Risk of Harmful Interference by LightSquared Emissions to GPS Receivers in Commercial Aviation

Test Site/Laboratory	Test Description and Methods	Scope and Objectives
Conducted Emissions Testing (under way as of mid-April)		
Zeta Associates Fairfax, Virginia This laboratory testing is similar to that required in the United States to certify on-ground and airborne GPS aviation receivers. However, newly written minimum operational performance standards are being provided by a working group of the RTCA special committee dedicated to GPS issues.	Emulated LightSquared satellite signals are being combined with simulated GPS/WAAS signals and fed into the receiver input port for the devices under test. "The emissions represent the output of the antenna unit and cabling designed for each tested receiver, including the effects of antenna filtering, low noise amplification and all incurred losses of signal," the TWG said.	For airborne GPS receivers, the testing follows procedures from RTCA standards. However, a variation of these procedures called "signal tailoring" adds the emissions anticipated from LightSquared base stations, the ancillary terrestrial component of the company's mobile satellite service, to the interference test environment.
Radiated Emissions Testing Within Anechoic Chamber (completed as of mid-April)		
USAF White Sands Missile Range, New Mexico Radiated emissions testing within an anechoic chamber has been performed using a test plan developed by a team led by the USAF GPS Directorate and approved in March 2011 by the directorate's chief engineer.	Simulated GPS signals were broadcast by one antenna within the facility, and emulated LightSquared base station signals were broadcast by another antenna. Aviation GPS receivers were located within one area of the chamber, connected to appropriate antennas, and the outputs of the receivers were logged as the LightSquared signal levels were varied.	The FAA has not yet determined the extent to which USAF results for these non-military aviation GPS receivers will be made available to the TWG for possible use in the final LightSquared Work Group report to the FCC by June 15, the TWG said.
Live Sky Radiated Emissions Testing (still pending as of mid-April)		
USAF Holloman Air Force Base, New Mexico (Expected flight phases and operational scenarios for these "live sky" GPS receiver tests appear in Table 2.)	Upon test plan approval, testing will be performed by FAA personnel and contractors in the vicinity of an actual LightSquared base station installed at this military base.	In some scenarios, aviation GPS receivers would be located in an aircraft on the ground, and their outputs would be logged as the LightSquared signal levels vary. In other scenarios, the same receivers would operate in flight around the LightSquared base station.

FAA = U.S. Federal Aviation Administration; FCC = U.S. Federal Communications Commission; GPS = global positioning system; LightSquared = LightSquared Subsidiary; TWG = LightSquared Technical Working Group; USAF = U.S. Air Force; WAAS = wide area augmentation system

Notes: The LightSquared Technical Working Group reported that in early 2011, FAA-funded laboratory testing by Zeta Associates would assess selected GPS position, navigation and timing devices for harmful overload/desensitization interference from components of the planned LightSquared satellite-terrestrial wireless broadband network. The devices are the Canadian Marconi GLSSU 5024; Garmin 300XL, GNS 430W and GNS 480; Rockwell Collins GLU–920, GLU–925 and GNLU–930 multimode receivers; Symmetricomm timing card (used for an FAA automation system); WAAS NovAtel G–II ground reference station; and Zyfer timing receiver (used for the WAAS ground network). The receiver list and test methods are subject to change.

Source: Joint reports to the U.S. Federal Communications Commission by LightSquared and the U.S. GPS Industry Council

Table 1

Live Sky Operational Scenarios Using Aircraft at Holloman Air Force Base

Flight Phase/Type of Field Test	Flight Conditions and Test Elements
En route GPS acquisition	The aircraft would be in level flight at 18,000 ft above ground level (AGL) using normal en route GPS-based navigation for a sufficient time to have up-to-date satellite ephemeris data, stored position, velocity and receiver clock bias/drift information, the TWG said, noting, "Normal navigation is then somehow interrupted for a short time (e.g., by a momentary aircraft power failure) and the receiver must re-establish navigation by a full 'warm-start' GPS-signal acquisition."
En route tracking/data demodulation	The aircraft would be in level flight at 18,000 ft AGL using GPS and WAAS satellite signals. Usability of WAAS signals for integrity and error correction depends on the aircraft position being within an area covered by WAAS ground reference stations. "Certain components of total radio frequency interference vary as a function of location (e.g., [GPS] self-interference, terrestrial radio frequency interference)," the TWG said.
Terminal area tracking/data demodulation	The aircraft would be in level flight with its GPS receiver antenna at an intermediate value between the en route and Category I precision approach scenarios, the TWG said. The airborne GPS antenna height is 1,756 ft (535 m).
Nonprecision approach tracking/data demodulation	RTCA-recommended GPS test procedures call for 100-ft (30-m) obstacle clearance surface distance (i.e., to the LightSquared base station as the closest possible obstacle and source of potential interference) with the Category I airborne antenna gain pattern below the aircraft.
Category I precision approach tracking/ data demodulation	RTCA-recommended GPS test procedures call for a 97-foot (30-m) obstacle clearance surface distance and a 175-ft (53-m) AGL antenna height for the GPS receiver.
Category II/III precision approach tracking/ data demodulation	RTCA-recommended GPS test procedures call for a 70-ft (21-m) obstacle clearance surface distance and an 85-ft (26-m) antenna height for the airborne GPS receiver. Such operations "require a Category II/III [ground-based augmentation system] to be installed at the airport," the TWG said.
Surface acquisition and tracking/ data demodulation	The aircraft would be at the gate or taxiing, and the antenna height of the aircraft GPS receiver would be 4 m (13 ft), a nominal height for a regional or business jet. The aircraft would be stationary or taxied slowly. The GPS receiver signal tracking and acquisition would be tested.

GPS = global positioning system; LightSquared = LightSquared Subsidiary; TWG = LightSquared Technical Working Group; WAAS = wide area augmentation system

Note: The National Space-Based Positioning, Navigation and Timing Systems Engineering Forum <www.pnt.gov/interference/lightsquared> will complete related studies by May 31.

Source: Joint reports to the U.S. Federal Communications Commission by LightSquared and the U.S. GPS Industry Council

Table 2

report said, offering a hint about types of mitigations that may be in the works.

The Aviation Sub-Team also is focusing on base station carrier frequency configurations that "have the potential to create third-order intermodulation products [that is, spurious signals overlapping GPS signals] that may fall within the GPS L1 band," the report said.

Giving a sense of how the LightSquared proceeding and wireless broadband pressures ultimately may influence GPS, the FCC said in March: "We emphasize that responsibility for protecting services rests not only on new entrants but also on incumbent users themselves, who must use receivers that reasonably discriminate against reception of signals outside their allocated spectrum. In the case of GPS, we note that extensive terrestrial operations have been anticipated in the L-band for at least eight years. We are, of course, committed to preventing harmful interference to GPS, and we will look closely at additional measures that may be required to achieve efficient use of the spectrum, including the possibility of establishing receiver standards relative to the ability to reject interference from signals outside their allocated spectrum."

To read an enhanced version of this story, go to <flightsafety.org/aerosafety-world-magazine/april-2011/lightsquared>.

Notes

1. The term "GPS receiver" has been used generically for various types of devices under test.
2. "LightSquared Subsidiary" encompasses the firm's most recent predecessor company names, Mobile Satellite Ventures and SkyTerra Communications.
3. The L-band is a general designation for frequencies from 1 GHz to 2 GHz. In the United States, the FCC has allocated L-band spectrum for mobile satellite service downlinks in the 1525–1544 MHz and 1545–1559 MHz bands and for mobile satellite service uplinks in the 1626.5–1645.5 MHz and 1646.5–1660.5 MHz bands.
4. Other companies authorized by the FCC to provide MSS ATC services are Globalstar, the DBSD North America subsidiary of ICO Global Communications, and Terrestar Networks, according to the federal government's *National Broadband Plan*.

J.A. Donoghue

A Flight Safety Foundation report is proposing guidelines to identify IAPs that could be decommissioned.

BY LINDA WERFELMAN

Shutting Down

About 800 instrument approach procedures (IAPs) to U.S. airports are underutilized or redundant and could be shut down, according to a Flight Safety Foundation report prepared at the request of the U.S. Federal Aviation Administration (FAA).[1]

The FAA's National Aeronautical Navigation Services (AeroNav Services) currently maintains about 17,000 IAPs (Tables 1 and 2, p. 37 and 38). The number is growing because of the ongoing transition from a ground-based navigation system to a satellite-based system — part of the FAA's air traffic control (ATC) modernization effort known as the Next Generation Air Transportation System, or NextGen.

Eventually, all aircraft will fly satellite-based approaches — including global positioning system (GPS) and area navigation (RNAV) approaches — but until the aircraft are appropriately equipped, older "legacy" navigation aids will continue to function and to serve as backups if GPS becomes unavailable because of interference.[2]

"With so many IAPs published, the FAA has expressed a desire to reduce a number of IAPs that are believed to be underutilized or redundant in nature," the Foundation's report said. "The FAA wants to invest its limited resources in the most beneficial IAPs, based on … RNAV and required navigation performance (RNP). By reducing the number of redundant or underutilized

approaches, the FAA can apply the cost savings toward the further expansion of RNAV and RNP throughout the NAS [National Airspace System]."

Retention Plans

The FAA's plans call for retention of a distance measuring equipment (DME) network to provide "a redundant RNAV capability for en route airspace above Flight Level (FL) 180" — approximately 18,000 ft, the report said.

A "reduced network" of VHF omnidirectional radios (VORs) will be maintained for backup use in low-altitude en route airspace and in IAPs. In addition, at least one instrument landing system (ILS) approach will be retained at airports currently served by ILS approaches, "unless the ILS is not necessary as part of the backup service" and unless current use is not sufficient to justify continuation of the ILS approach, the report said, noting that these steps are intended to "reduce the threat to air transportation from disruption of GPS services in today's operational environment."

NextGen Progress

One measure of progress in the transition to NextGen is the number of aircraft with the avionics required to fly GPS IAPs. The Foundation estimates that, of 9,977 jet air carrier aircraft in the United States in 2009, more than 7,500 were equipped for LNAV (lateral navigation), LNAV/VNAV (lateral navigation/vertical navigation) or LPV (localizer performance with vertical guidance).

The Foundation's report also said that, of 202,101 general aviation aircraft in the United States, 75,730 had "approach-capable IFR [instrument flight rules] GPS equipage."

"The [equipment] estimates indicate that the majority of aircraft operators are utilizing ILS for precision approaches and some type of RNAV procedure for nonprecision approaches (RNAV and/or RNP)," the report said.

In meetings with representatives of airspace user organizations,[3] "it became immediately clear that RNAV/RNP is a mainstay for many operators and that NDB [nondirectional beacon] approaches are no longer desired, except when no other option is available," the report said. None of the organizations opposed an FAA proposal to eliminate "all but a small number of NDBs."

The airspace user groups voiced concerns, however, about the extent to which VORs — especially regularly used VORs — would be included in any shutdown of IAPs.

Feedback received from the user groups indicated that the FAA could "expect to reduce the number of IAPs by at least 800, provided that the airspace users respond as favorably to the FAA proposal as they did to the initial survey," the report said. "This would represent a 12 percent reduction in ground-based IAPs and a 4 percent reduction in the FAA's total IAP inventory of public procedures."

Identifying and Canceling IAPs

The Foundation's recommended process for identifying and canceling IAPs resembles the processes used by the FAA in the past but calls for improved coordination with ATC facilities and other government agencies.

Proposing a list of IAPs for shutdown could take 60 to 90 days, the Foundation said, noting that after the list has been compiled, the FAA should schedule a 30-day comment period to receive feedback from associated ATC facilities and the Department of Defense. Then the list should be published for public comment; after a review of these comments, the FAA should develop its response and, if necessary, schedule discussions with some of those who submitted comments. After that, the FAA should finalize the list, explain the decision in writing to each commenter and set dates for the shutdowns, the Foundation's report said.

FAA Satellite-Based Instrument Approach Procedures*

Procedure Type	Number of Procedures
GPS stand-alone	425
RNAV (LNAV minimums)	4,909
RNAV (VNAV minimums)	2,280
RNAV (LPV minimums)	2,329
RNAV (RNP minimums)	237
RNAV (RNP specials)	7
Total	**10,187**

*as of Sept. 23, 2010

GPS=global positioning system; LNAV=lateral navigation; LPV=localizer performance with vertical guidance; RNAV=area navigation; RNP=required navigation performance; VNAV=vertical navigation

Source: U.S. Federal Aviation Administration, Flight Safety Foundation

Table 1

FAA Ground-Based Instrument Approach Procedures*

Procedure Type	Number of Procedures
ILS	1,339
ILS (Category II)	170
ILS (Category III)	121
ILS PRM	44
MLS	0
LOC	1,427
LOC (back course)	81
NDB	953
TACAN	32
VOR	1,366
VOR/DME	969
VOR/DME RNAV	33
LDA	33
LDA PRM	4
PAR	8
ASR	242
SDF	11
Total	**6,838**

*as of Sept. 23, 2010

ASR=airport surveillance radar; DME=distance measuring equipment; ILS=instrument landing system; LDA=localizer type directional aid; LOC=localizer; MLS=microwave landing system; NDB=nondirectional beacon; PAR=precision approach radar; PRM=precision runway monitor; RNAV=area navigation ; SDF=simplified directional facility; TACAN=tactical air navigation; VOR=very high frequency omnidirectional radio

Source: U.S. Federal Aviation Administration, Flight Safety Foundation

Table 2

The document called for "an aggressive cancellation strategy that eliminates the approaches within two 56-day update cycles" — a reference to the frequency with which the government publishes IAP charts and related information.

The Foundation recommended a two-phase effort for eliminating the selected IAPs, with the first phase for NDB and VOR/DME RNAV procedures, and the second phase to "deal with a set of under-utilized or redundant VOR procedures."

Both phases could be completed in 12 to 18 months, the report said.

Phase 1

Before the FAA publishes its proposal to cancel nearly all NDB and VOR/DME RNAV IAPs, the agency should conduct a thorough analysis, the Foundation said.

The report said that the analysis should include a review of all IAPs at the airports where approaches were designated to be shut down "to more fully evaluate the potential impact. The Foundation recommends reviewing the airports to ensure that other RNAV and ground-based IAPs with lower minimums are available to the same runway ends, and recommends that the FAA coordinate with DOD [U.S. Department of Defense] officials."

The report also said that the FAA's analysis should determine if NDB approaches are being used by flight schools that train student pilots who will work in countries where NDBs are still crucial in instrument navigation. In those cases, the NDBs should not be decommissioned, the report said.

In addition, the report said, "The FAA should ensure that any airport that currently is served by VOR/DME RNAV procedures also has another ground-based IAP, as well as another RNAV-based IAP. The VOR/DME RNAV IAP should be retained only if it is the only approach to the airport."

Phase 2

The second phase of the IAP decommissioning initiative calls for identifying airports with VOR approaches and approaches with circling minimums that are candidates for elimination.

"Nearly all [airspace user groups] agreed that they are willing to consider a reduction in IAPs with circling minimums, especially if all runways are served with a straight-in IAP," the report said.

The report described several conditions that the Foundation said should rule out shutting down a specific airport's IAP:

- All approaches at the airport are RNAV/RNP IAPs;
- The airport has only one VOR or ILS approach;
- The airport has only one ground-based IAP in addition to an RNAV IAP; or,
- FAA AeroNav Services has identified the airport as needing VOR approaches in case of GPS interference.

A separate set of conditions will be applied to other airports to designate their VOR and/or circling minimums IAPs for cancellation if the airport meets the following criteria:

- It is one of the 100 busiest airline airports;
- It has approaches that involve a VOR that is scheduled for decommissioning within the next three fiscal years;
- It has an NDB IAP or a VOR/DME RNAV IAP;
- It has two or more VOR IAPs in addition to RNAV IAPs; or,

- It has an ILS and a VOR IAP, in addition to more than one RNAV IAP.

After these two reviews have been conducted, selected airports — each with multiple ground-based IAPs — will be evaluated individually.

"At this point," the report said, "the process will become much more detailed, and an airport-by-airport review will be required to apply the criteria and considerations provided by the airspace users during the Foundation's interviews."

Among those considerations — according to the operators who were interviewed as part of the Foundation's study — is the need to "align any efforts associated with VOR disestablishment with efforts to identify and eliminate redundant or underutilized VOR approaches."

The FAA should examine underutilized VOR IAPs at the 100 busiest airline airports while also evaluating the entire group of nonprecision IAPs at these sites, the operators said, adding that the agency should consider not only IAP utilization data but also the broader impact on the airports of shutting down a VOR approach.

At other airports with multiple approaches that might be eliminated, the operators said, "don't eliminate too many approaches per reduction cycle."

Other criteria recommended by the operators included:

- "If there are RNAV procedures to both ends of the runway, and if there is an ILS and a VOR approach to the same runway and a VOR only on the opposite-direction runway, propose eliminating the VOR that is serving the same runway end as the ILS";
- "If there are multiple VOR approaches that are eligible for removal from an airline airport, consider retaining VOR/DME IAPs … because they often deliver the lowest minimums"; and,
- "If there are multiple VOR approaches that are eligible for removal from a non-airline airport, consider eliminating the VOR/DME IAP and retaining the VOR IAP because the majority of non-airline aircraft do not carry a stand-alone DME. Most general aviation aircraft rely on GPS as their source of DME."

Circling minimums could be removed if there are RNAV IAPs to each runway end and if multiple ground-based IAPs also are available, the operators said.

They also said that eventual decisions on decommissioning IAPs should take into account how often the approaches are used in instrument meteorological conditions.

"Those interviewed remain supportive of RNAV, and they generally support the FAA's efforts to utilize RNAV more and nonprecision ground-based navigation approaches less," the Foundation said.

'Focus on RNAV'

The Foundation's recommendations emphasized the need for the FAA to "focus on RNAV everywhere" to aid in the move away from ground-based navigation.

"The Foundation recommends that the FAA establish and publish a policy that informs operators that ATC operations in the United States are now RNAV-based," the report said. "That is, RNAV operations are the normal method of operating, and operations utilizing ground-based navigation aids (while still supported), are not the normal method of operating in the NAS."

Another recommendation asked the FAA to publish RNAV IAPs at all airports that have ground-based procedures

The FAA will evaluate a number of instrument approach procedures, including some based on NDBs, top photo, and VORs, to determine whether they should be eliminated.

Photos: © Brazil Air Traffic Control

to "ensure that no airport has a ground-based procedure as the only option."

All GPS overlay procedures — procedures in which pilots are authorized to use GPS avionics while flying specified nonprecision IAPs — should be eliminated, the Foundation said, and all GPS and RNAV IAPs should become stand-alone IAPs.

"If special conditions exist that would result in higher minimums for a stand-alone GPS, the FAA should develop strategies to ensure that a new RNAV approach has minimums that are equal to, or better than, the ground-based navigation approach," the report said.

The FAA also should increase the use of IAPs that include VNAV, the report said, noting that Foundation data have shown "a dramatic increase in risk of accidents by turbine-powered aircraft when the use of vertical guidance is not available on IAPs."

Low-altitude "V" airways and high-altitude "J" airways also should be eliminated, the report said. "Because the majority of active IFR aircraft are equipped with RNAV, the FAA could normalize non-airway-based routing capability" — one of the more significant changes accompanying the transition to satellite navigation.

Steps also should be taken to ensure that "city-pair RNAV routings are shorter than 'V' and 'J' airway-based city-pair routings," the report said.

In addition, the report said, the FAA should consider a requirement that, if an aircraft is equipped with a wide area augmentation system (WAAS) receiver for any aviation application, the receiver must also be used for navigation.[4]

Notes

1. Flight Safety Foundation. *A Recommended Process: Safely Reducing Redundant or Underutilized Instrument Approach Procedures*. FAA Grant No. 2010G023. A special report prepared at the request of the FAA. March 2011.
2. GPS interference is being addressed through the continuing development of spectrum diversity and improved anti-jamming capabilities.
3. The organizations were the Aircraft Owners and Pilots Association; Air Line Pilots Association, International; Air Transport Association; National Business Aviation Association; Regional Airline Association; and U.S. Air Force.
4. The WAAS provides pilots with guidance for both vertical and horizontal navigation throughout all phases of flight. It works with GPS to enhance the accuracy of GPS position information.

BARS Training Advances

The global demand for raw materials has caused a significant growth in mining operations, with an equivalent level of growth in the operations of contract aviation companies involved in supporting the resource industry. For many smaller aircraft operators, this has meant an increase in operating capacity and, in a number of cases, the introduction of larger and more complex aircraft types. This growth typically presents a degree of organizational change, with concurrent risk, that often is not clearly understood.

Risk oversight and management are key elements of governance for any corporation, and not just from the commercial perspective. While managing risk has for a long time been a recognized responsibility of high-risk industries, the safety of third-party providers of services, including aviation services, is measured by a variety of standards.

As the number of aircraft operators involved in providing third-party aviation services has grown, so, too, has the need increased for resource companies to apply prudent governance measures to ensure that these operators meet standards that should, in the majority of cases, exceed regulatory requirements.

Individual audits of aviation service companies performed within the conventional system typically are not conducted to a broadly accepted standard and often are measured only against the audit company's standards. The audit reports may also include subjective comments guided in part by the bias of the auditor, which can lead to a significant degree of report variability.

In addition, the frequency with which aircraft operators are audited is problematic. For example, one helicopter operator received 27 separate audits in a 12-month period, incurring significant direct and indirect costs.

In recognition of these issues, Flight Safety Foundation (FSF), in conjunction with a number of major resource companies, last year developed the Basic Aviation Risk Standard (BARS) with the goal of uniting all resource industry aviation service providers under a single comprehensive risk standard through which a single audit will certify an operator for all BARS member organizations (BMOs).

Greg Marshall, recently appointed director of the FSF BARS program, said, "With a BARS audit, subjectivity is removed, leaving a succinct but comprehensive report that provides for a truly risk-based approach to aircraft operator assessment."

Bristow Helicopters, Australia, was recently audited under the BARS standard. Bob Turner, Bristow's chief pilot, noted, "The auditors were very good at the process and carried out a totally objective audit according to the guidelines."

Since BARS was introduced, 12 resource sector companies have become BMOs, with three more in the process of joining. The United Nations' World Food Programme, a significant global user of outsourced aviation support, recently committed to becoming a BMO (*ASW*, 3/11, p. 24).

To date, 26 BARS audits have been conducted, with 20 more planned over the coming weeks. Five accredited audit companies, three of which are based in Australia, conduct these audits.

The BARS Program Office in Melbourne also manages accredited auditor courses from which 57 auditors have graduated at this writing. In addition, seven aviation coordinator training courses have been conducted in four countries, with 84 attendees. Two more auditor courses are planned in the coming months.

"Some operators are intuitively noting that a successfully completed BARS audit will produce a commercial advantage," Marshall said. "An operator who has undertaken a BARS audit against a well-defined and widely accepted standard has a distinct competitive advantage when it comes to providing services to end user BMOs."

Checklist Confusion

Corporate operators have little guidance for modifying manufacturers' checklists.

BY DAVID M. BJELLOS

© Chris Sorensen Photography

Unlike airliner manufacturers that typically produce relatively simple checklists, knowing their customers will modify them to fit their operating needs, business aircraft manufacturers produce checklists that tend to be overly long and better suited to engineers and flight test crews than to pilots. However, corporate aviation department managers and chief pilots do not have the regulatory direction or clear guidance afforded their air carrier counterparts, and much confusion exists about the acceptability and legality of modifying manufacturers' checklists.

Program managers at the major flight training centers in the United States estimate that well in excess of 50 percent of corporate operators of transport category turbine aircraft use modified checklists during normal flight operations. During simulator training, however, their pilots are required either to use "approved" checklists — almost exclusively those provided by the original equipment manufacturers (OEMs) — or to comply with specific U.S. Federal Aviation Administration (FAA) provisions to use their modified checklists during required recurrent training and proficiency checks. The FAA still requires the use of an approved checklist for aircraft type-specific initial training.

To use a modified checklist at an FAA-approved training center, a company operating under the general operating and flight rules of U.S. Federal Aviation Regulations Part 91 must apply directly to the OEM for a "letter of no objection" (LONO). The application must include the modified checklist and a summary of the differences between the modified checklist and the OEM checklist. A LONO is issued if the OEM's flight operations staff finds no technical objections to the use of the modified checklist for training. The company then must send the LONO and the modified checklist to the training center before its pilots arrive for training.

Real-World Disconnect

The process of gaining approval to use a modified checklist for training is onerous, time-consuming and problematic. Thus, pilots typically use the OEM checklist for training and their modified version operationally. This constitutes a disconnect between operating the aircraft in the "real world" and in the training environment.

The disconnect negates the concept of "train as you fly, fly as you train." And it begs the question: If Part 91 allows us to use any checklist we feel fulfills the need for safe flight operations, why must we comply with restrictions on the use of that checklist in the simulator?

Based on its investigation of the fatal Hawker accident in Owatonna, Minnesota, the U.S. National Transportation Safety Board (NTSB) has recommended to the FAA that Part 135 air taxi and commuter operators, and Part 91 Subpart K fractional ownership operators be allowed to use the same checklists in simulator training that they use in normal line operations (see story, p. 16).

The implications and intent of this recommendation are clear and compelling, and it should apply to other Part 91 operators.

Normalization of Deviance

The term *normalization of deviance* was coined after the space shuttle Challenger disaster and underscores the importance of identifying repeated, error-prone actions that have become "normal operations."

The shuttle was so technologically advanced and required such tedious attention to detail that actual inspection and repair times far overran the planned turnaround times. Checks that were mandatory became optional, and subtle clues were overlooked or ignored. The mold was cast for failure, and when failure occurred, it did so in dramatic fashion.

Identifying and correcting error-prone activities are at the core of safety management system (SMS) philosophy. The FAA should apply this philosophy to the situation in which crews train with one checklist and fly with another, and it should reappraise its requirements for Part 142 training centers.

FAA Recommendations

While researching this topic, the author requested a formal response from the FAA to the following questions:

- What expectations does the FAA have, and what steps can an aviation department take, to address customizing a checklist for its individual needs?
- What position does the FAA take on those of us (Part 91 corporate flight departments) who use customized checklists?
- What steps would the FAA recommend that Part 91 corporate flight departments take to ensure our checklists meet the "acceptable standard" that exists for Part 121 and Part 135 operators?

The response from the FAA's Flight Standards Service on March 25 was as follows:

"For Part 91 operators that are not operating under Subpart K, there is no FAA requirement for acceptance or approval of modified checklists. … The FAA encourages all Part 91 operators to utilize checklists when appropriate and ensure their (aircraft manufacturer or operator modified) checklist is complete and contains no errors. Part 91 operators, especially those operating large aircraft, may want to consider the following information prior to making modifications to a manufacturer's checklist:

- "Advisory Circular (AC) 120-71A, *Standard Operating Procedures for Flight Deck Crewmembers*, contains information on proper checklist usage;
- "FAA Order 8900.1, Volume 3, Chapter 32, Section 12, contains the guidance that FAA inspectors use when accepting or approving checklists for Part 121 and 135 operators. While this guidance does not apply to Part 91 operators, it may be useful when reviewing Part 91 checklist modifications;
- "Run validation tests of nonstandard, abnormal and emergency checklists in realistic real-time scenarios in a simulator;
- "Seek assistance and cooperation of the manufacturer or other operator that has already conducted a validation test of a procedure or checklist;
- "Determine the safety and effectiveness of any addition, deletion or change of sequence in the steps of checklists, through validation testing;
- "When using a curriculum in a Part 142 training center, non-certificated operators must follow and complete FAA procedures required to replace the center's approved checklist with the operator's checklist. Operators must also ensure the center's personnel are trained on differences (see FAA Order 8900.1, Volume 3, Chapter 54, Section 6); [and,]
- "Emphasize correct checklist usage in training. For example, operators should emphasize and train crewmembers to not overlook items on checklists, verify settings visually, and minimize outside interruption of checklist verification."

While the FAA's response provides a great deal of data for review, it does not address the fundamental question of exactly what is acceptable.

Best Practice vs. Regulation

The FAA and the European Aviation Safety Agency exert little or no oversight of business aircraft operators in such critical areas as flight and duty time limitations; fatigue management and long-range flight planning; overwater operations; security; and functional training beyond the Part 61.58 requirement for pilot-in-command proficiency checks.

Instead, most corporate aviation operators have adopted industry best practices formulated by organizations including Flight Safety Foundation and the International Business Aviation Council (IBAC). The keystone is the Industry Standard for Business Aviation Operations (IS-BAO), which was "developed by the industry for the benefit of the industry," according to IBAC. Voluntary in nature, IS-BAO certification shows the regulator that an operator is complying with industry best practices and operating to the highest standards possible.

Business aircraft manufacturers defer the use of checklists to the discretion of their customers. The OEMs are required to provide revisions as necessary to meet compliance and operational issues, but the time that would be involved in formulating and issuing revisions to checklists tailored to a specific customer's needs likely would be outstripped by the rapid pace of technology and airspace system design changes.

Corporate flight operations are as diverse as the business purposes they serve. Yet, the level of safety that business aviation provides is extraordinary. Professionally crewed Part 91 aircraft have a safety record that is statistically equal to that of their Part 121 counterparts. That may explain why aviation managers, chief pilots and flight crews take such a vested and passionate interest in checklist construction and content.

There has been no civil liability precedent in U.S. courts regarding alleged misuse of modified checklists. However, a legal basis for liability exists for improper use of an OEM checklist, so a valid argument cannot be made that using only an OEM checklist will reduce liability and satisfy SMS criteria for risk mitigation. In any event, the post-accident outcome in a court of law could be determined by the savvy arguments of the attorneys, rather than the good intentions of operators, despite the aviation department's best efforts. Proper use of either a modified or OEM checklist is critical to safe and conservative flying.

David M. Bjellos manages an aviation department that operates fixed-wing and rotary-wing aircraft. He holds a master's degree in aeronautical science from Embry-Riddle Aeronautical University and is a member of the Flight Safety Foundation Corporate Advisory Committee and the Chief Pilots Roundtable.

BY J.A. DONOGHUE | FROM ISTANBUL

Stop Stalling

Loss of control accidents have safety experts looking closely at stall prevention and recovery training.

Aerodynamic stalls lately have had roles in an unusually large number of accidents, helping to boost the "loss of control" accident category to the top of the rankings of killer events in aviation. So it was not surprising that one of the most compelling segments of Flight Safety Foundation's 23rd annual European Aviation Safety Seminar, in Istanbul, Turkey, concerned how to deal with the onset of stalls and how to train for stall recovery.

After a lot of discussion, Claude Lelaie, special adviser to the Airbus president and chief operating officer, cut to the heart of the remedy for pilots finding themselves in a stall or near-stall condition: "If you push on the stick, you will fly!"

This seemingly obvious bit of wisdom needed to be said in light of the number of fatal accidents and near-accidents in the past decade that wouldn't have happened if the flying pilots had just followed Lelaie's sage but simple advice.

Michael Coker, Boeing's senior safety pilot, flight technical and safety, recited a litany of accidents in which forward stick pressure was either never used or was insufficient. The crew of the Colgan Air Bombardier Q-400 that crashed near Buffalo, New York, U.S., in 2009 "never put the stick forward of neutral," Coker said. The West Caribbean McDonnell Douglas MD-82 that, in 2005, crashed in Venezuela after the crew, reacting to a stall at cruise altitude, "went to full aft controls all the way to the ground." In 2004, the crew of a Pinnacle Bombardier CRJ-200, near Jefferson City, Missouri, U.S., starting from a high cruise altitude, "overrode multiple stick-pusher activations all the way to the ground." More recently, in the Air New Zealand/XL Airways Airbus A320 accident in France, the aircraft was 57 degrees nose-up at 3,800 ft and 40 kt airspeed — "high power, high pitch, full stall," Coker said.

© Damir Cudic/istockphoto

J.A. Donoghue

These accidents, and other incidents that nearly became accidents, occurred because recovery attempts failed, Coker said, and some of the blame for that can be laid on the training, or the lack of training, that line pilots receive.

Stall-recovery training in turbine airplanes, what little there is of it, typically emphasizes a minimum reduction in pitch attitude to minimize altitude loss. During recurrent training, this procedure usually has been demonstrated at an altitude of 10,000 ft, Coker said, while recent stall accidents or incidents happened either from cruise altitude or on short final approach. "Don't mandate altitude or minimum loss of altitude. … The solution is to follow proper procedures, reduce the angle-of-attack [AOA] and set the appropriate power." Coker's focus on less-than-full power is related to the trim state of the aircraft, noting a Thompsonfly Boeing 737-300 that nearly crashed in the United Kingdom when a full-power go-around in a poorly trimmed state resulted in an extreme nose-high condition that the crew overcame with great difficulty.

In a presentation coordinated with Coker's, Lelaie said that major aircraft manufacturers have combined to push for changed stall-recovery procedures. "The key point — nose down, pitch to reduce AOA — is nothing new.

"At the first indication of a stall during all flight stages except liftoff, disconnect the autopilot and autothrust, put the nose down (you may use nose-down trim, but this is not essential) and retract the speed brakes."

Lelaie warned that simulator training for stalls does not replicate actual experience very well, especially pre-stall and stall buffet, and, in actual approach stalls, a clear break may not be evident, but the aircraft may show signs of the nose moving laterally.

Airbus did a series of stall-recovery procedure tests, using an A340-600 operating in direct control law. Airbus concluded that the test results showed that the procedure calling for the pilot flying to "apply full thrust while maintaining altitude can contribute to reaching stall conditions," Lelaie said.

"After coordination with other manufacturers in the [U.S. Federal Aviation Administration] stall recovery training working group, a basic training sequence has been developed and then validated," he said. "It includes stall recovery demonstration in the following conditions:

- "Low altitude, clean and landing configuration;
- "High altitude; and,

- “Specific exercise with startle factor.

“Except for the last exercise, there is a demonstration followed by the execution.”

Using four experienced Airbus training pilots, the company ran a series of actual stalls at altitude, in part to determine the fidelity of the full flight simulator experience to real life. It also produced a few, somewhat predictable, results: “There was some initial reluctance from one pilot, the most experienced, to positively reduce AOA by moving the stick forward before increasing thrust, even in normal [control] law. When out of the stall, we discovered a tendency of the aircraft to pitch up due to thrust increase, which led to a secondary stall warning.”

One of the main conclusions of the Airbus tests is that while simulator buffeting in the pre-stall and stall condition should be improved to better replicate real life, the simulator remains a viable device for stall training, especially in the medium-to-low altitude regimes.

Paul J. Kolisch, Mesaba Airlines supervisor, flight operations training, noted, “Virtually every pilot we train on a stick pusher will pull against the pusher.”

The traditional training regime for stalls has little to do with reality, Kolisch said. “The approach-to-stall training has traditionally had pilots following a pedantic choreography, hand flying to an approach to stall while taking special care not to trim the aircraft so much that it cannot be controlled to maintain attitude and altitude during recovery. … Pilots have had more difficulty satisfying evaluators with the setup than with the stall recovery. The training is akin to synchronized swimming: It requires a good deal of skill and preparation but has nothing to do with swimming safely across a river.”

Preparing and properly executing go-arounds, the presentation of Bertrand de Courville, corporate safety manager, Air France, also had a loss-of-control theme. He related the stories of several crews that lost situational awareness and, while executing the go-around, kept pushing the aircraft’s nose down, especially during the level-off phase, despite repeated warnings from the terrain awareness and warning system. “Neither of the pilots could explain why they caused the pitch-down,” he said about one incident; in another, the aircraft pulled over 3 g (i.e., three times normal gravitational acceleration) when the crew finally recovered, and in another the airplane crashed as the crew flew it into the ocean while trying to go around.

Go-arounds remain relatively rare events, de Courville said. On average, there are only one or two go-arounds per 1,000 arrivals, one per year for short-haul pilots, and as few as one every 5 to 10 years for long-haul crews. Nonetheless, about 30 percent of all fatal accidents every year are associated with go-around decisions, with weather being a prominent factor in many of these accidents, as well. “There is a potential accident rate reduction of 25 percent if better go-around decisions are made,” de Courville said.

A stall also was involved in the 2009 crash of a Turkish Airlines 737 on approach to Amsterdam Schiphol Airport, but it was a consequence of a minor failure in the aircraft’s automation system, not caught by the pilots in time, that caused the airplane to be too slow at an altitude too low for recovery, said Turkish Flight Safety Officer Aydın Özkazanç, an A330 first officer.

The weak link in this automation story was one of the radio altimeters, and “it didn’t fail, it just became ‘non-normal,’” Özkazanç said. “There were no warnings, no drastic change in the cockpit, nothing to draw the pilots’ suspicion.” Accidents such as this, he said, raise the question: “How suspicious of automation should you be? Automation doesn’t mean automatic. It still needs people.

“Technology needs to trigger human interest into what it is doing,” he said. There are many ways in which automation can go adrift. “It can fail

Left to right: Coker, Kolisch, Lelaie, Learmount, Özkazanç and de Courville

fully, it can fail partially, it can produce unexpected results, and some failures are difficult to detect. Humans form the last line of protection" against the consequences of automation failure, yet "sometimes system design prevents" this intervention. Özkazanç used the term "the automation surprise" for a problem that suddenly reveals itself fully.

David Learmount, operations and safety editor, *Flight International* magazine, expressed similar thoughts about the subject. "Automation can do strange things when something in the system goes slightly wrong. So, by all means, use automation, but don't ever trust it completely; monitor what it is doing to ensure it makes sense.

"In modern airplanes, it is tempting to trust the automated systems because they normally provide very accurate flight path control — better than a pilot can fly — and they hardly ever fail. And the airlines encourage pilots to use them.

"But pilots need to be frequently retrained never to ignore the basics, like airspeed, power setting, aircraft attitude and altitude. Recognizing subtle automation failures should be a part of routine recurrent training, but it is not a regulatory requirement, so airlines don't do it."

Training was a recurring theme in the seminar, with Mike A. Ambrose, director general, European Regions Airline Association, discussing the importance of training in a different context, as a defense against legal charges in the wake of an accident.

"During the past decade, it is unlikely that any day has passed in which senior airline executives, somewhere in the world, have not been faced with criminal charges arising from an air accident. Criminalization of air accidents has become a new and threatening feature in the responsibilities of directors and key post-holders," Ambrose said.

"Airline boards and senior management need to prepare not only for an accident or incident, but also for potential criminal prosecution. Preparation should include various measures, including insurance, training, media strategy and establishing within the airline, in anticipation of a future incident/accident, the capability of conducting a parallel internal air accident investigation. Failures by senior managers to take the necessary measures can expose companies and their employees to 'corporate manslaughter' charges," he said.

One of the problems Ambrose sees in defending against post-accident charges is the lack of consistency in the training. "Why does one training organization teach more than 30 ways of flying a well-known and widely used aircraft type?" he asked.

"The recurrence of replica accidents [the same type of accident repeated] is distressing, frustrating and avoidable; no formal requirements exist to teach new-intake pilots the lessons learned from tragic experience. Addressing this knowledge shortfall might help crew detect situations that could otherwise lead to repeating past mistakes."

The international aviation system might be considered safe, but it has ceased becoming safer, Learmount said, pointing out little or no change in accident rates since 2003 or 2005, depending on the data used. "The status quo: Aviation has reached the limits of performance that can be achieved under the traditional ways of thinking and operating. The traditional way of thinking is that safety is achieved by compliance with regulations. This is a mentality that abrogates personal responsibility for company standards," Learmount said, echoing Ambrose's ideas.

Higher goals must be set for progress to resume, Learmount said. "After an accident, a CEO with that mindset would say: 'It wasn't our fault. We operated within the law.' That is a fatalistic/deterministic, passive attitude. The thinking that will cause a resumption of safety improvement sees safety management going well beyond compliance. Remember, the law sets minimums; compliance with the law results in minimum standards."

Photos: J.A. Donoghue

BY RICK DARBY

Side Trips

Runway conditions were only one factor in excursions, U.K. data show.

Flight crew actions or failures to act were the most significant factors in fatal runway excursions, according to data analyzed by a U.K. Civil Aviation Authority (CAA) task force.

The task force was one of seven groups formed to address the top seven safety risks previously identified by the CAA. "The task forces were explicitly asked not to duplicate work but to identify where any additional safety intervention was required," says the report on the initiative.[1] The Runway Overrun or Excursion Task Force based its study and recommendations on "information [that] was already available from CAA data," the report says. No specific information about the study period of the database is given in the report.

The task force looked at runway excursions from two angles: fatal accidents and U.K. mandatory occurrence reports (MORs).[2] A runway excursion was defined for the task force's purposes as "an aircraft inadvertently or uncontrollably leaving a runway end or side, usually during landing but also during takeoffs, especially following a rejected takeoff."

Considering fatal runway excursions, the most significant factors ranked by numbers of accidents were "crew," "aircraft," "weather," "runway" and "air traffic control (ATC)," in that order (Figure 1).

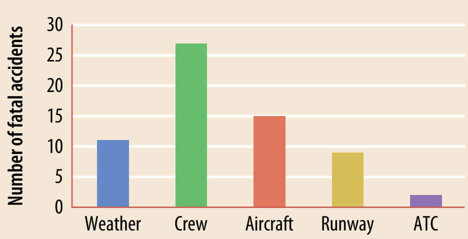
A further breakdown of factors involved in fatal runway excursions shows the most frequent factor to be "aircraft other technical failure," the "other" distinguishing this category from "brakes technical failure" and "aircraft prior faults" (Figure 2). That factor was found in 12 of the accidents. "Crew: flight handling" was found in 10 accidents. Runway surface conditions played a relatively small role.

The largest number of MORs involved weather as a factor (Figure 3). Runway conditions were the next-most frequent category.

In the more detailed analysis, "runway surface water" and "rain" were the most common factors, cited in 15 and 14 MORs respectively (Figure 4, p. 52). "Surface winds" and "aircraft technical failure" were also prominent in the tally.

To sum up, it appeared from the data that crew and aircraft factors played the largest roles in fatal accidents involving excursions, while weather and runway conditions were most frequent in the hazardous situations reported.

Most Significant Factors, Fatal Runway Excursions



ATC = air traffic control

Source: U.K. Civil Aviation Authority

Figure 1

Those seeking to supplement the CAA data may consult the *Runway Excursion Risk Reduction Toolkit*, produced by the International Air Transport Association and Flight Safety Foundation, based on research by the Runway Safety Initiative members. Among the tool kit's findings were that during a 14-year period, 97 percent of runway accidents were excursions. Although a low percentage of excursion accidents were fatal, the large number of excursions meant that excursions resulted in more fatalities than incursions — traffic conflicts on runways and taxiways.

Controlled Flight Into Terrain

The report also cites data from the CAA Controlled Flight Into Terrain Task Force:

- For the 10-year period 1998 to 2007, 57 — 23 percent — of 245 worldwide fatal accidents involved controlled flight into terrain (CFIT).[3]
- Of those 57 CFIT accidents, 39, or 68 percent, occurred during the approach or final approach phases of flight, with 59 percent of the 39 involving nonprecision approaches. The rest of the approach or final approach CFIT accidents occurred during visual or "user-defined" approaches.
- The top five causal factors in the fatal CFIT accidents were, in order, "lack of positional awareness in air"; "omission of action/inappropriate action"; "failure in crew resource management (crosscheck/coordinate)"; "slow and/or low on approach"; and "press-on-it is," or self-directed pressure to continue the approach.

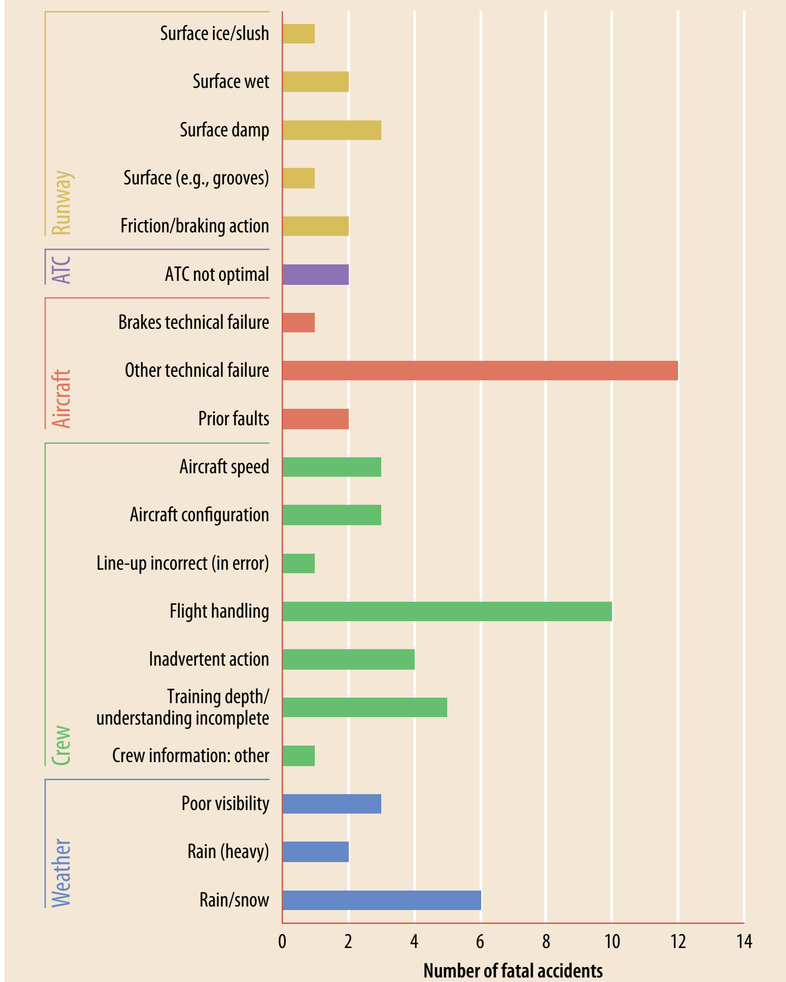
"The 'omission of action/inappropriate action' causal factor related largely to continued descent below [safe] altitudes or decision heights without visual reference and/or failure to fly a missed approach," the report says.

The task force analyzed "serious" CFIT-related MORs involving U.K. aircraft and/or U.K. airspace.[4]

Of the 24 occurrences meeting the criteria, 17, or 71 percent, occurred during the approach phase. Of those 17, 65 percent involved nonprecision or circling approaches.

"Most of the occurrences involved vertical flight path management errors such as significant deviations below the glideslope and/or cleared altitude, descent below decision/[safe] attitudes

Factors, Fatal Runway Excursions

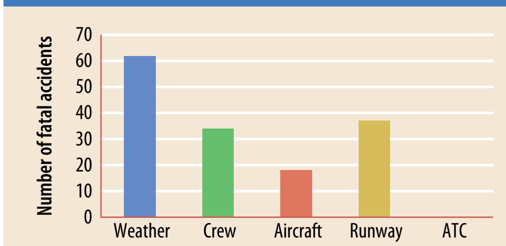


ATC = air traffic control

Source: U.K. Civil Aviation Authority

Figure 2

Most Significant Factors, U.K. MOR Runway Excursions

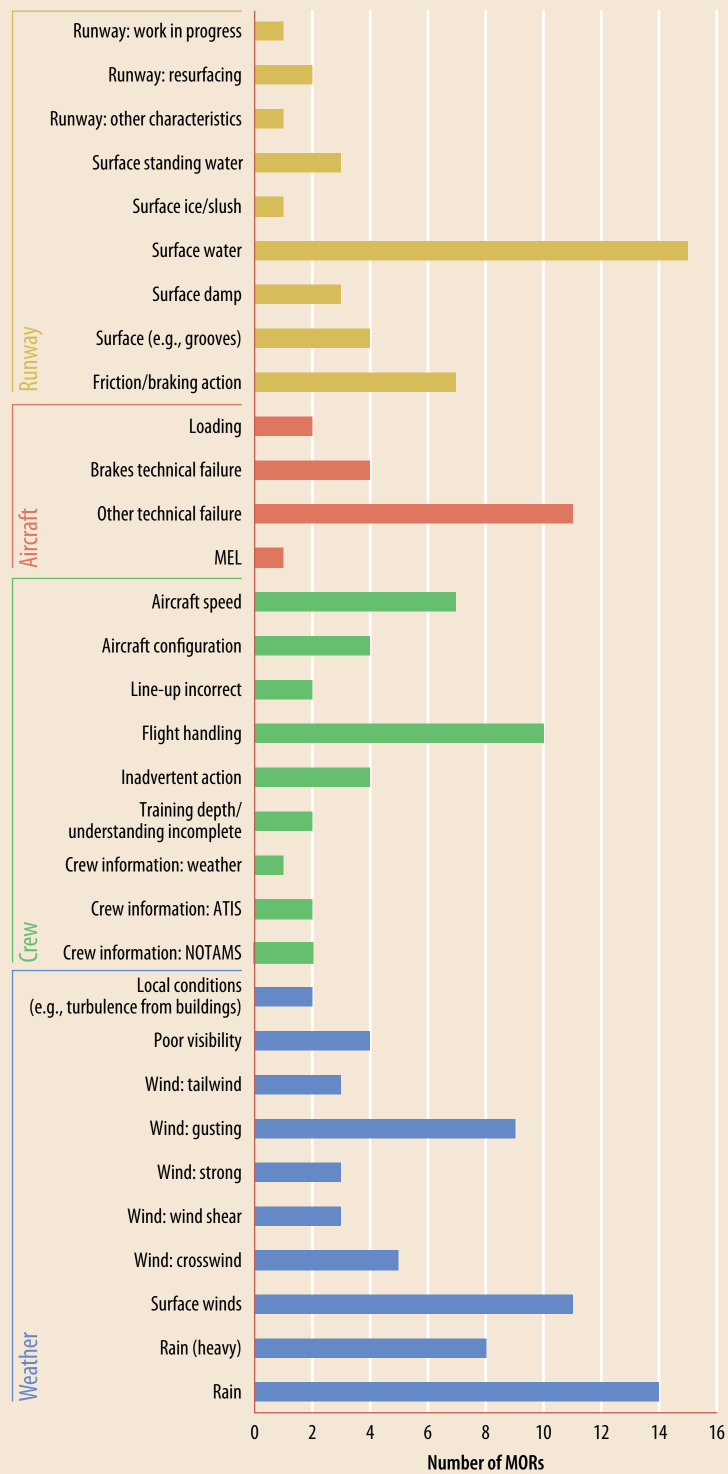


ATC = air traffic control;
MOR = mandatory occurrence report

Source: U.K. Civil Aviation Authority

Figure 3

Factors, MOR Runway Excursions



ATIS = automatic terminal information service; MEL = minimum equipment list; MOR = mandatory occurrence report; NOTAMS = notices to airmen

Source: U.K. Civil Aviation Authority

Figure 4

without the required visual reference and unstable approaches," the report says.

Other common factors included non-adherence to standard operating procedures such as required callouts, the report says.

Interventions and warnings helped resolve a situation safely in some cases. The report cites ATC actions such as "issuing a go-around instruction, providing heading guidance and questioning [the] aircraft's altitude as a positive factor in 13 occurrences. Ground-proximity warning system or enhanced ground-proximity warning system [EGPWS] alerts or warnings helped to avert accidents in 10 occurrences.

"However, EGPWS warnings were insufficient for the two most severe occurrences, in which U.K. aircraft descended to within 56 ft and 121 ft of terrain at Addis Ababa [Ethiopia] and Khartoum [Sudan] respectively," the report says. "The common link in these two cases was that GPS [global positioning system] was not used as a source of position information for TAWS [terrain awareness and warning system]."

Notes

1. CAA. "CAA 'Significant Seven' Task Force Reports." CAA paper 2011/03. March 2011. Available via the Internet at <www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=4452>.

2. MORs, described in U.K. CAA Publication CAP 382, *The Mandatory Occurrence Reporting Scheme: Information and Guidance*, <www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=214>, are required reports to the CAA for hazardous situations that occur or would have occurred without corrective action, and "whenever the reporter believes that there is a safety operational, maintenance or airworthiness-related issue that should be investigated by the CAA."

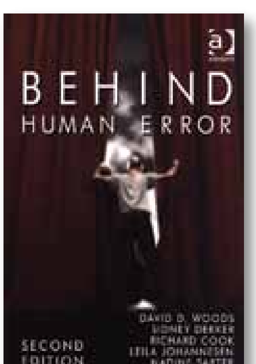
3. The fatal accidents in the database involved jet or turboprop airplanes with original certified takeoff weights greater than 5,700 kg/12,500 lb, engaged in passenger or cargo flights.

4. The data included reportable accidents and/or grade A or grade B MORs involving jet or turboprop airplanes with original certified takeoff weights greater than 5,700 kg/12,500 lb, engaged in passenger or cargo flights. Grade A and grade B MORs are defined by the CAA as "high severity."

The View From the Sharp End

The first error is trying to define human error.

BY RICK DARBY



BOOKS

The Law of Stretched Systems

Behind Human Error

Woods, David D.; Dekker, Sidney; Cook, Richard; Johannesen, Leila; Sarter, Nadine. Farnham, Surrey, England and Burlington, Vermont, U.S. Second edition, 2010. 271 pp. Figures, tables, references, index.

Most scientific and academic studies begin with a definition of the subject or problem. It's only logical for researchers to agree first on precisely what is being studied. But this book's authors say that defining human error is not only pointless but impossible.

"The search for definitions and taxonomies of error is not the first step on the journey toward safety; it is not even a useful step, only a dead end," according to the authors.

"Each organization or industry feels that their progress on safety depends on having a firm definition of human error," they say. "Each group seems to believe that such a definition will enable creation of a scorecard that will allow them to gauge where organizations or industries stand in terms of being safe. But each organization's search for the definition quickly becomes mired in complexity and terms of reference. Candidate definitions appear too specific for particular areas of operations, or too vague if they are broad enough to cover a wider range of activities."

It might be possible for medical researchers to define a disease they want to cure, although that is not always the case. But human error belongs to a different class of phenomena, involving fantastically complex interactions of causal factors.

"The definitions [of human error] involve arbitrary and subjective methods of assigning events to categories," the authors say. They describe three typical, and inconsistent, senses in which the term "error" is applied.

The first sense is described as "the cause of failure," as in the phrase "the event was due to human error." It implies that some type of behavior generates a failure, leading to "variations on the myth that safety is protecting the system and stakeholders from erratic, unreliable people."

A second way of using the expression "error" is simply as a synonym for the failure itself. The authors say, "In this sense, the term 'error'

'Choosing among the many candidates for a standard changes what is seen as an error in fundamental ways.'

simply asserts that the outcome was bad, producing negative consequences."

Finally, "error" can be viewed as a process, or more often, as not following the right process. "However, the enduring difficulty is that there are different models of what the process is that should be followed: for example, what standard is applicable, how standards should be described and what it means when deviation from the standards does not result in bad outcomes," they say.

While it might seem that the context alone should clarify which sense of "error" is meant, the authors say that the versions are often confused with one another, and that the same person can slip from one concept to another unconsciously.

Anyway, they argue, *none* of the senses is adequate.

Seeing error as cause tends to stop the analysis prematurely at an obvious and convenient point, instead of looking also at precursors and less evident factors. "Error-as-cause leaves us with human performance divided in two: acts that are errors and acts that are non-errors," the authors say. "But this distinction evaporates in the face of any serious look at human performance … .

"Instead of finding error and non-error, when we look deeply into human systems at work, we find that the behaviors there closely match the incentives, opportunities and demands that are present in the workplace. Rather than being a distinct class of behavior, we find the natural laws that influence human systems are always at work, sometimes producing good outcomes and sometimes producing bad ones. Trying to separate error from non-error makes it harder to see these systemic factors."

The trouble with defining error as consequence, the authors say, is that "this sort of definition is almost a tautology: It simply involves renaming preventable harm as error. But there are a host of assumptions packed into 'preventable' and these are almost never made explicit. We are not interested in harm itself but, rather, how harm comes to be. … Closer examination of 'preventable' events shows that their preventability is largely a matter of wishing that things were other than they were."

Error as deviation from correct process "collides with the problem of multiple standards," the authors say. "Choosing among the many candidates for a standard changes what is seen as an error in fundamental ways. Using finer- or coarser-grained standards can give you a very wide range of error rates. In other words, by varying the standard seen as relevant, one can estimate hugely divergent 'error' rates. Some of the 'standards' used in specific applications have been changed because too many errors were occurring or to prove that a new program was working.

"This slipperiness in what counts as a deviation can lead to a complete inversion of standardizing on good process: Rather than describing what it is that people need to do to accomplish work successfully, we find ourselves relying on bad outcomes to specify what it is that we want workers not to do. Although often couched in positive language, policies and procedures are often written and revised in just this way after accidents."

Terminology aside, people do sometimes unintentionally act in ways that lead to bad consequences. If it is futile and even misleading to chase definitions of human error, what *can* we do?

Various answers to that question form the substance of *Behind Human Error*, which contains a rich discussion and recommendations. What follows are a few excerpts from "10 of the most important steps distilled from the research base about how complex systems fail and how people contribute to safety."

Recognize that human error is an attribution. "It is not an objective fact that can be found by anybody with the right method or right way of looking at an incident," the authors say. "It is … just one way of telling a story about a dreadful event (a first story). … The first story after celebrated accidents tells us nothing about the factors that influence human performance before the fact. Rather, the first story represents how we, with knowledge of the outcome and as stakeholders, react to failures."

Pursue second stories. "Go beyond the first story to discover what lies behind the term 'human error,'" the authors say. "When you pursue second stories, the system starts to look very different. You can begin to see how the system moves toward, but is usually blocked from, accidents. Through these deeper insights, learning occurs, and the process of improvement begins."

Escape from hindsight bias. The authors say, "With knowledge of the outcome, we simplify the dilemmas, complexities and difficulties practitioners face and how they usually cope with these factors to produce success. The distorted view leads people to propose 'solutions' that actually can be counterproductive if they degrade the flow of information that supports learning about systemic vulnerabilities and if they create new complexities [that add difficulties to] practice. In contrast, research-based approaches try to use various techniques to escape from hindsight bias."

Understand the work performed at the sharp end of the system. The "sharp end" — where actions are performed in real-world operations — is the confluence of the many stimuli, demands and pressures of the system. "Improving safety depends on investing in resources that support practitioners in meeting the demands and overcoming the inherent hazards in that setting," the authors say. "Ironically, understanding the sources of failure begins with understanding how practitioners create safety and success first; how they coordinate activities in ways that help them cope with the different kinds of complexities they experience."

They emphasize the importance of understanding practices from the point of view of those performing the actions, avoiding the so-called "psychologist's fallacy," which happens when "well-intentioned observers think that their distant view of the workplace captures the actual experience of those who perform technical work."

Search for systemic vulnerabilities. "After elucidating complexities and coping strategies, one can examine how these adaptations are limited, brittle and vulnerable to breakdown under differing circumstances. Discovering these vulnerabilities and making them visible to the organization is crucial if we are to anticipate future failures and institute change to head them off."

Examine how economic, organizational and technological change will produce new vulnerabilities and paths to failure. Some researchers have found what they call the Law of Stretched Systems: "Every system operates always at its capacity. As soon as there is some improvement, some new technology, we stretch it."

In other words, technical improvement first goes into enhancing productivity, and only afterward — if at all — into safety. Change "pushes the system back to the edge of the performance envelope," the authors say.

"Change under resource and performance pressures tends to increase coupling, that is, the interconnectedness between parts and activities. … Increasing the coupling between parts in a process changes how problems manifest, creating or increasing complexities such as more effects at a distance, more and faster cascades of effects, and tighter goal conflicts." This leads to "new cognitive and collaborative demands which contribute to new forms of failure."

The authors recommend "focusing your resources on anticipating how economic, organizational and technological change could create new vulnerabilities and paths to failure."

Tame complexity with new forms of feedback. "A basic pattern in complex systems is a drift toward failure as planned defenses erode in the face of production pressures, and as a result of changes that are not well assessed for their impact on the cognitive work that goes on at the sharp end," the authors say. "Continuous organizational feedback is needed to support adaptation and learning processes. To achieve this, you should help your organization develop

'A basic pattern in complex systems is a drift toward failure as planned defenses erode in the face of production pressures.'

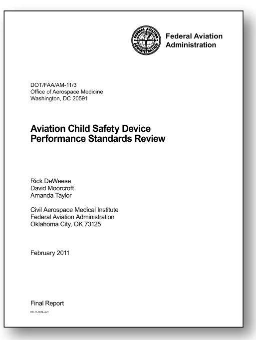
and support mechanisms that create foresight about the constantly changing shape of the risks it faces.”

REPORTS

Restraining Order

Aviation Child Safety Device Performance Standards Review

DeWeese, Rick; Moorcroft, David; Taylor, Amanda. U.S. Federal Aviation Administration (FAA) Civil Aerospace Medical Institute. DOT/FAA/AM-11/3. February 2011. 18 pp. Tables, figures, references.


Federal Aviation Administration

DOT/FAA/AM-11/3
Office of Aerospace Medicine
Washington, DC 20591

Aviation Child Safety Device Performance Standards Review

Rick DeWeese
David Moorcroft
Amanda Taylor

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

February 2011

Final Report

Development of U.S. standards for child restraint systems (CRSs) appropriate to transport aircraft seats has been awkward. CRSs based on Federal Motor Vehicle Safety Specification (FMVSS)-213, originally the only means for approval, exhibited “poor performance” in aircraft seats, the report says. The motor vehicle standards were later supplemented by the SAE International Aerospace Standard (AS) 5276/1, *Performance Standard for Child Restraint Systems in Transport Category Airplanes* and by FAA Technical Standard Order (TSO)-100b.

Later, aircraft passenger seats evolved in ways not envisioned by FMVSS-213 and TSO-C100b.

“The test requirements call for a combination of worst-case belt anchor location, belt tension and seat cushion properties/dimensions that were typical at the time the specifications were written,” the report says. “These parameters no longer appear to be representative of the majority of transport airplane seats. As such, difficulty complying with the standards based on these test parameters may be inadvertently hindering the availability of aviation-specific CRSs.”

Newer aircraft passenger seats meet the more stringent requirements of TSO C-127a, which specifies “16 g [16 times the standard acceleration of gravity]” structural integrity. “With the increased use of TSO C-127a seats, this combination of requirements may not be representative of the majority of current aircraft seats; thus, difficulties in developing aviation child safety devices (ACSDs) that meet these very conservative specifications may be inadvertently hindering the availability of such devices,” the report says. Faced with outmoded requirements, potential suppliers have requested revisions to the standard, and no proposed ACSD has been granted approval under the existing TSO (see “Collective Wisdom,” p. 23).

In addition, U.S. Federal Aviation Regulations (FARs) Parts 91, 121, 125 and 135 have been revised in light of TSO-C100b to allow use in aircraft of ACSDs that do not have FMVSS-213 approval.

“The specifications in AS5276/1 and TSO-C100b were developed to complement those in FMVSS-213; however, removing the requirement for ACSD to meet FMVSS-213 may have removed some requirements that are useful in ensuring safety,” the report says.

“Revision of the regulatory requirements in order to accommodate these new devices … has inadvertently removed some applicable requirements that are not duplicated in the TSO. Such requirements include: design specifications for occupant support surfaces, belt/buckle strength and durability tests, and defined occupant restraint configuration, geometry and adjustment range. In addition, FMVSS-213 has been revised significantly since TSO-C100b was written, improving several aspects that could benefit existing aviation standards and provide a safety benefit for ACSDs. These include use of advanced test dummies, enhanced test dummy preparation and positioning procedures, improved head injury assessment, and better CRS installation procedures.”

The report concludes that analysis of the various standards, as well as the current seat types in U.S. transport airplanes, “suggests that revisions to both the aerospace standard and the TSO based on technological evolution, improvements to test equipment and test procedures that are more representative of the aircraft environment would advance the development of ACSDs while maintaining or improving child safety.”

Brake Anomaly Causes Overrun

Business jet was slow to accelerate for takeoff, then could not be stopped.

BY MARK LACAGNINA

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

JETS

'Massive Overheating'

Cessna Citation CJ1. Substantial damage. No injuries.

Inadvertent application of the parking brake or binding of the wheel brakes during the initial takeoff roll likely caused the brakes to overheat and disintegrate, resulting in the pilot's inability to safely reject the takeoff from Leeds Bradford International Airport in West Yorkshire, England, the afternoon of June 7, 2010, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The Citation overran the 2,113-m (6,933-ft) runway, rolled down an 83-m (272-ft) slope, crossed a road, slid sideways through the airport perimeter fence and came to a stop against trees. The aircraft's nose landing gear detached, the right main landing gear collapsed, and substantial damage to the wings and nose occurred during the accident. The pilot and his passenger, who owned the Citation, escaped injury.

The aircraft was departing for a flight to Cannes, France. Visual meteorological conditions (VMC) prevailed, with light and variable winds from the north, when the airport traffic controller told the pilot to line up and wait on Runway 14.

"After stopping on the runway, the pilot applied the parking brake," the report said. The pilot later told investigators that he could not recall if he released the parking brake after receiving takeoff clearance.

As the aircraft reached 80 kt, the pilot checked that the two airspeed indications agreed but sensed that the aircraft was not accelerating normally. He told the passenger, "Something's not quite right," and attempted to reject the takeoff.

He closed the throttles, applied maximum wheel braking, extended the speed brakes and radioed, "Abort, abort, abort." The controller asked if he needed assistance, and the pilot replied, "Stand by." The aircraft began to veer left and reacted slowly to the pilot's application of full right rudder.

The airport's airside safety coordinator, who was in a stationary vehicle near the runway, saw flames emerge from the right main landing gear about two seconds after the pilot reported that he was aborting the takeoff.

The controller also saw a burst of flame and radioed, "You've got a fire on the right-hand side."

"The pilot reported that, by that stage, the brakes were totally ineffective," the report said. "As the aircraft approached the end of the paved surface, the pilot attempted to pull the emergency brake handle, but he accidentally pulled the auxiliary gear [extension] handle instead, which was immediately to its right. When he managed to pull the emergency brake handle, it had no effect, and the aircraft ran off the end of the runway. … As the aircraft left the hard surface, the owner moved the throttles to the 'OFF' position to shut down the engines."

Examination of the right wheel brake assembly revealed "massive overheating," the report said. "The right brake … and most elastomeric seals had disintegrated. The left brake had not broken up, but similar … overheating had caused some melting and distortion of friction pads and stators."

A trail of hydraulic fluid was found on the runway. "The trail of hydraulic fluid and the fire reported by witnesses were consistent with hydraulic fluid coming into contact with very hot components of the right brake," the report said.

The report concluded that "both brakes overheated due to their being on, at least partially, during the takeoff roll and also possibly during taxi to the runway." However, there was insufficient evidence to support or discount any of the three likely scenarios considered during the investigation: that the parking brake had not been disengaged before takeoff; that toe braking inadvertently was applied during the takeoff roll; or that the brakes were binding.

The parking brake is engaged by pressing the toe brakes and pulling the handle to trap hydraulic pressure in the brake lines. If sufficient pressure is applied to the toe brakes before the handle is pulled, the system is designed to trap enough brake pressure to prevent the aircraft from moving even if full thrust is applied. However, if the handle is pulled after the toe brakes are pressed just enough to bring the aircraft to a stop from taxiing speed, the trapped pressure likely is not sufficient to lock the wheels against takeoff thrust.

'Both brakes overheated due to their being on, at least partially, during the takeoff roll.'

Although the pilot could not recall whether he released the parking brake before takeoff, initial postaccident examination of the aircraft by airport personnel revealed that the parking brake handle was in the disengaged position. However, the report said there was insufficient evidence to corroborate that the parking brake was released fully before takeoff.

The possibility that one or both occupants applied the toe brakes "seemed unlikely, especially as equal pressure would have to have been applied to both brake pedals, but the possibility could not be discounted," the report said.

A review of brake-related incidents involving Citation CJ1s could not corroborate "anecdotal evidence" that the brakes are prone to binding, the report said. It cited a takeoff that was rejected successfully at Jersey, Channel Islands, in September 2008 after the flight crew sensed slow acceleration and were told that smoke was emerging from the right brake assembly. The air safety report subsequently filed by the operator said, "There is a known problem with binding brakes on the CJ series, whereby if the parking brake is applied when the brakes are hot, the brake discs can sometimes bind."

Although Cessna told the AAIB that its records showed that binding brakes are not a common problem in CJ1s, "this possibility also could not be discounted" as a factor in the accident at the Leeds Bradford airport, the report said.

Adrift in the Clouds

Boeing 737-400. No damage. No injuries.

Miscommunication and neglect of standard operating procedure (SOP) were among the factors that caused the 737 to stray beyond the confines of a nonprecision approach while descending in instrument meteorological conditions (IMC) to land in Darwin the morning of Dec. 17, 2008, according to the Australian Transport Safety Bureau (ATSB).

When the aircraft broke through the clouds about 700 ft above ground level (AGL), the airport traffic controller saw that it was not aligned with the runway and told the flight crew to go around. The crew complied and subsequently landed the aircraft without further incident.

The ATSB's final report on the incident, issued in March 2011, said that the aircraft was inbound on a scheduled passenger flight to Darwin from Denpasar, Indonesia. The estimated time of arrival was 0500 local. There were widespread rain showers in the Darwin area; visibility at the airport was 4,000 m (2 1/2 mi) in moderate rain, and the ceiling was broken at 500 to 700 ft.

The 737 was over the Timor Sea, about 200 km (108 nm) northwest of Darwin, when the crew diverted 40 km (22 nm) north of course to avoid thunderstorms. An approach controller subsequently told the crew that when they were clear of the weather, they could expect clearance to fly directly to NASUX, the initial approach fix for the VHF omnidirectional radio (VOR) approach to Runway 11. NASUX is 17.6 km (9.5 nm) northwest of the runway threshold.

The aircraft was almost directly north of the airport when the crew reported that they were clear of the hazardous weather. "The approach controller asked the flight crew if they could accept a clearance to track to NASUX," the report said. The crew replied that they could intercept the final approach course, 105 degrees, about 12 km (6 nm) from the runway threshold — that is, inside NASUX.

"The approach controller then instructed the flight crew to maneuver west of NASUX as required to track direct to NASUX for a straight-in approach to Runway 11 via the Runway 11 VOR approach and to contact the tower when established on final," the report said. "In response, the flight crew correctly read back the tower frequency and included the phrase 'straight-in approach Runway 11' in their transmission [but did not read back] the approach controller's instruction to track via NASUX for the Runway 11 VOR approach."

The controller repeated the clearance for a "straight-in-approach via NASUX," but the crew's reply indicated only that they understood they were cleared for a straight-in-approach. The crew then initiated a descent below 3,000 ft, the initial approach altitude, without clearance. The 737 was nearing 2,000 ft when the controller reminded the crew that the initial approach altitude was 3,000 ft. "The flight crew responded that they were at 2,000 ft to 'intercept … runway course,'" the report said.

The aircraft was 12 km northwest of the airport when the crew requested clearance to descend to 1,500 ft. The controller cleared them to descend to 1,600 ft, the published minimum safe altitude. After leveling at 1,600 ft, the crew turned left 8 km (4 nm) from the runway threshold to track the final approach course, 105 degrees.

The 737 was not established on the VOR approach, however. Contrary to company SOP that requires crews to monitor raw data from the approach aids — in this case, the VOR and the distance measuring equipment — the crew was using as their primary means of navigation the electronic flight instrument system's map mode, which was displaying data provided by the inertial reference system (IRS). Because of drift, or the tendency for IRS positioning accuracy to deteriorate during long overwater flights, the IRS data were not suitable for an instrument approach. As a result, the aircraft was unknowingly being flown parallel to, and 600 m (1,969 ft) north of the VOR final approach course as the crew continued the descent toward 500 ft, the minimum descent altitude.

The IRS data were not suitable for an instrument approach.

"In consequence, the aircraft was below the minimum [safe] altitude in IMC without being on an instrument approach, increasing the risk of collision with terrain," the report said.

As the crew complied with the airport traffic controller's instruction to go around, the aircraft reached a minimum altitude of 513 ft, or about 417 ft AGL, abeam the runway threshold. The crew then conducted the VOR approach via NASUX and landed the 737 on Runway 11.

The aircraft was of Indonesian registry, but the report did not specify the nationality of the pilots. Nevertheless, it said, "There was no evidence that language proficiency or comprehension of spoken English were factors in the incident."

Communication, however, was a contributing factor. The crew's incomplete readbacks of their clearances should have prompted the approach controller to seek correct readbacks, the report said, noting that the absence of challenges to their readbacks "likely confirmed for the flight crew that their erroneous interpretation of the controller's instructions was, in fact, the controller's intent."

Damage Undetected Before Takeoff

Bombardier Challenger 604. Substantial damage. No injuries.

Visibility was 1 1/4 mi (2,000 m) in heavy rain, the ceiling was broken at 400 ft, and surface winds were from 120 degrees at 16 kt, gusting to 23 kt, at Vineyard Haven, Massachusetts, U.S., the afternoon of Sept. 27, 2009. Nearing the airport, the pilot-in-command (PIC) elected to use an approach speed of 135 kt and a flap setting of 30 degrees for the instrument landing system (ILS) approach to Runway 24.

Although the airplane operating manual (AOM) recommended selection of the minimum flap setting appropriate for the runway when wind shear is expected, "the airplane was certified for normal landings with the flap system at 45 degrees, only," said the report by the U.S. National Transportation Safety Board (NTSB). "The manufacturer did not provide for a flap setting of 30 degrees except for a flap system malfunction."

Both pilots said the approach was stabilized until the Challenger encountered wind shear when the PIC began the landing flare 15–20 ft above the runway. The airplane touched down hard at about 150 kt, bounced about 20 ft off the runway, touched down again nose-wheel-first and bounced about 10 ft before being landed.

After the two passengers deplaned, the pilots inspected the airplane but found no abnormalities. During departure about 15 minutes later, the nose landing gear light remained illuminated when the crew attempted to retract the landing gear. The PIC decided to divert the flight to Windsor Locks, Connecticut, where the airplane was landed safely.

"Subsequent inspection of the airplane by a Federal Aviation Administration inspector revealed substantial damage to the nose section of the airplane, which included wrinkling at the forward pressure bulkhead," the report said.

Data downloaded from the enhanced ground-proximity warning system (EGPWS) indicated that a "TOO LOW, FLAPS" warning had been generated at about 300 ft AGL during the approach to the Vineyard Haven airport and that a "SINK RATE" warning had been generated at about 50 ft AGL. "There were no wind shear alerts generated by the EGPWS," the report said.

The report noted that the AOM reference about using the minimum flap setting when wind shear is expected was deleted by the manufacturer after the accident.

'Dust' Factors in CB Panel Fire

Airbus A319-131. Minor damage. No injuries.

The commander's primary flight display and navigation display went blank when the no. 1 generator was engaged after the no. 1 engine was started in preparation for departure from London Heathrow Airport the night of March 15, 2009. The flight crew conducted the relevant checklists and, after resetting the generator, heard a loud noise that emanated from the right circuit breaker (CB) panel. The pilots detected the odor of an electrical fire but saw no smoke.

The flight crew shut down the engines and instructed the ground crew to tow the A319 back to the stand, where the 87 passengers and six crewmembers deplaned normally.

"Subsequent investigation revealed evidence of a significant electrical overheat in the area behind the right CB panel," the AAIB report said. "The initiation of the electrical fault and subsequent overheating could not be fully established but was considered to be most likely due to the presence of a loose article. The presence of 'dust' [fibrous material] in the area was also considered a contributory factor."

The loose article "could have come from a number of sources, and it is likely that it vaporized … due to the fire," the report said. It noted that Airbus in 2007 introduced requirements for periodic inspection and cleaning of electrical wiring interconnection systems (EWIS). The requirements were to be incorporated by operators no later than March 2011.

The introduction of the new EWIS requirements into scheduled maintenance "should reduce the recurrence of electrical faults from foreign objects and debris," the report said.

TURBOPROPS

Overrun on Short, Wet Runway

Beech King Air A200. Substantial damage. No injuries.

The pilot's decision to land with a slight tail wind on a short, wet, ungrooved and down-sloping runway resulted in a long landing and an overrun during a functional check flight at Bridgewater (Virginia, U.S.) Air

Park the afternoon of Sept. 25, 2008, according to NTSB.

The pilot told investigators that he had planned a "quick, around-the-pattern" post-maintenance flight to check the pressurization system. Surface winds at a local airport were from 070 degrees at 5 kt when the pilot took off, with a maintenance technician aboard, from Bridgewater's Runway 33. The runway is 2,745 ft (837 m) long, with 2,377 ft (725 m) available for landing due to approach obstructions and a displaced threshold.

After performing the pressurization checks, the pilot attempted to land on Runway 33. "The pilot executed a go-around after touchdown on his first landing attempt, stating that something did not feel right," the NTSB report said.

On the second attempt, the King Air touched down more than 300 ft (91 m) beyond the displaced threshold. The pilot applied wheel braking and reverse thrust, but "because the runway was wet, the braking action was poor, and he realized that he was probably going to overrun the end of the runway," the report said. "However, he elected not to go around due to the airplane's low indicated airspeed, the configuration of the airplane, the remaining runway, the rising terrain, and the presence of houses."

Wet grass off the end of the runway further decreased braking action. The King Air rolled down a steep embankment and into a river, sustaining substantial wing damage. The pilot and maintenance technician escaped injury.

The report said that a contributing factor in the accident was the absence of guidance by the airplane operator for conducting functional check flights.

Access Door Separates on Takeoff

Bombardier Dash 8-402. Substantial damage. No injuries.

Unscheduled maintenance and a daily inspection had been performed by maintenance personnel before the flight crew began preparations for an early morning departure with 40 passengers and four crewmembers from Southampton (England) Airport on April 22, 2010. Neither the flight crew nor the ground crew who deiced the aircraft noticed any abnormalities.

"A pilot sitting in a parked aircraft saw a panel thrown upwards from [the Dash 8] during its takeoff roll," the AAIB report said. "He reported this to ATC [air traffic control], who passed the information to the flight crew." The crew returned to the airport and landed the aircraft without further incident.

Examination of the Dash 8 revealed that the inboard forward access door on the no. 2 engine had separated and struck the leading edge of the right wing during takeoff. "The lower latches of the door were found in the fully open position, indicating that the door had not been secured following maintenance," the report said.

'The lower latches of the door were found in the fully open position.'

Aquaplaning Report Not Relayed

ATR 72-500. Substantial damage. No injuries.

A notice to airmen advised that only 1,703 m (5,588 ft) of Runway 27 was available for takeoff and landing because of runway maintenance at Mumbai (India) Airport on Nov. 10, 2009. Light rain was falling and there was standing water on the runway when the flight crew of an Airbus A319, which preceded the ATR 72 on approach, told the airport traffic controller that their aircraft had aquaplaned and struck two runway edge lights during the landing roll.

The controller acknowledged the report and sent airport personnel to inspect the runway. "The [controller] was not familiar with the terminology of 'aquaplaning' and, not realizing the seriousness of it, cleared [the ATR 72 crew] for landing" without relaying the A319 crew's aquaplaning report, said the Air Safety Directorate of India in its final report on the accident. The controller told the ATR crew that the runway was wet but did not mention that there were patches of water on the surface.

The ATR 72's approach was not stabilized; the aircraft was substantially above the required glide path. The PIC disengaged the autopilot and increased the aircraft's nose-down pitch attitude. The report said that although the EGPWS generated continuous "SINK RATE" warnings, the crew did not perform a go-around.

The aircraft touched down at an abnormally high airspeed with about 1,000 m (3,281 ft) of runway remaining. The tires aquaplaned on the wet runway, and the aircraft did not decelerate adequately although full reverse thrust and maximum wheel braking were applied by the pilots.

The aircraft was skidding left and nearing the end of the runway when the PIC initiated a right turn. The aircraft veered off the right side of the runway, rolled over several exposed drainage pipes and struck a ditch before coming to a stop. The 38 passengers and four crewmembers were not hurt, but the aircraft was substantially damaged.

PISTON AIRPLANES

Self-Induced Pressure to Land

Partenavia P68C. Destroyed. Three fatalities.

A charter operator based in Key West, Florida, U.S., received a late-night call from a person who was on a kidney-transplant waiting list. "The individual stated that an organ was available in Gainesville [Florida] and that he'd have to get there quickly for surgery the following morning," the NTSB report said.

The Partenavia departed from Key West at 0037 local time on Nov. 7, 2008, with the individual and his wife aboard. The airplane was nearing Gainesville when a flight service specialist told the pilot that the airport had 1/4 mi (400 m) visibility in fog and an indefinite ceiling with vertical visibility of 100 ft.

The pilot conducted the ILS approach to Runway 29 and descended below the published decision height. The airplane struck 100-ft trees about 4,150 ft (1,265 m) from the runway at 0246.

"Given that the pilot was aware of the weather conditions before and during the approach, it is possible that the pilot's goal of expeditiously transporting a patient to a hospital for an organ transplant may have affected his decision to initiate and continue an instrument approach while the weather conditions were below the published minimum requirements for the approach," the report said, noting that better weather conditions prevailed at nearby airports.

Simulated Engine Failure

Piper Twin Comanche. Destroyed. Two Fatalities.

Two private pilots were aboard the PA-39 when it took off from Vannes (France) Meucon Aerodrome the afternoon of Aug. 25, 2007. The pilot in the right seat owned the aircraft; he had a current multiengine rating but did not have a flight instructor certificate. The pilot in the left seat likely was the pilot flying; she held a multiengine rating that had expired five years earlier, according to the report by the Bureau d'Enquêtes et d'Analyses.

Surface winds were from 060 degrees at 10 kt when the Twin Comanche took off from Runway 04, which is 1,530 m (5,020 ft) long. Witnesses told investigators that the takeoff roll was abnormally long and the groundspeed seemed low when the aircraft lifted off the runway. It then rolled right and struck the ground.

Examination of the wreckage revealed that the right engine was producing low power on impact. "No technical faults with this engine or the corresponding fuel supply system were found," the report said. "It is therefore likely that the reduced power of the right engine was the result of a deliberate action by one of the two pilots, conducted as part of an engine-failure-during-takeoff exercise. … The decision to perform training flights outside the formal framework of instruction and the lack of the requisite qualifications were major contributing factors in this accident."

Mallard Penetrates Windshield

Beech B55 Baron. Substantial damage. One serious injury.

The public-use airplane was being used for an instrument instructional flight from Bismarck to Hazen, both in North Dakota, U.S., the night of April 6, 2010. VMC prevailed, and the pilot flying was wearing a view-limiting device when the Baron struck several mallards while descending through 4,200 ft over Center, North Dakota.

The pilot later told NTSB investigators that he heard a loud pop and felt a "violent rush of air" when the bird strike occurred. "The flight instructor, seated in the right seat, sustained serious injuries when one duck penetrated the right cockpit windshield and struck his face," the report said.

The pilot declared an emergency, turned back to Bismarck and landed the Baron without further incident. Examination of the airplane revealed that the leading edge of the right wing and the nose cone also had been damaged during the bird strike.

HELICOPTERS

Tail Strike on Ship Deck

Bell 222B. Substantial damage. No injuries.

Crewmembers of a ship anchored in the Gulf of Mexico, about 71 nm (131 km) from Galveston, Texas, U.S., were directing the pilot to land on a "winch only" area of the ship's deck the afternoon of April 8, 2009, the NTSB report said.

The tail rotor struck a valve assembly protruding from the deck, and the helicopter yawed about 60 degrees right. The tail then struck the ship's side rail, and the helicopter came to rest upright on the deck. None of the five occupants of the helicopter and no one aboard the ship was hurt. Examination of the helicopter revealed substantial damage to the fuselage, tail boom, horizontal stabilizer and the tail rotor blades, rotor hub and gearbox.

In his accident report, the pilot wrote, "Pilots need to use extreme caution when conducting confined-area shipboard landings. Be especially vigilant for obstacles that are painted the same color as the deck."

Windsock Cited in Control Loss

Bell 206L-3. Substantial damage. Two serious injuries, one minor injury.

An improperly installed windsock was a factor in the LongRanger's loss of tail rotor effectiveness while landing at a private helipad in Mysore, India, the morning of Jan. 18, 2008, said the report by the Air Safety Directorate of India.

The windsock had been installed close to a wall and to trees that obstructed the free flow of air around it, the report said. The pilot, who was making his first landing at the helipad, told investigators that the windsock was indicating winds from 050 degrees at 3 kt, so he conducted the initial approach on a 050-degree heading.

The pilot said that he was establishing a hover at 10 ft over the center of the helipad when the helicopter began to yaw right. "He immediately lowered the collective lever and applied left rudder pedal; however, the helicopter continued to turn right until it contacted the ground," the report said. The left landing skid separated, and the LongRanger rolled over. Two passengers were seriously injured; one passenger and the pilot sustained minor injuries; and one passenger escaped injury.

The report said that rather than the head wind indicated by the windsock, the helicopter likely encountered a tail wind or left crosswind while at high power and in low-speed flight, which resulted in loss of tail rotor effectiveness.

Wires Struck During Autorotation

Schweizer 269C-1. Destroyed. Two fatalities.

The helicopter departed from Weston Executive Airport in Dublin, Ireland, for an instructional flight the afternoon of April 1, 2009. ATC received no further radio transmissions from the helicopter after it was flown into uncontrolled airspace, said the report by the Irish Air Accident Investigation Unit.

A search was launched the next morning, after family members reported that the pilot and flight instructor were missing. A coast guard helicopter crew found the wreckage of the Schweizer near Kilshanchoe.

Witnesses said that the helicopter had disappeared after making a steep descent. Investigators concluded that the Schweizer likely had struck disused electrical power lines while transitioning from a practice autorotative landing. "The external surface of the cables had oxidized over time from bright aluminum to a dull gray color," the report said.

Preliminary Reports, February 2011

Date	Location	Aircraft Type	Loss Type	Injuries
Feb. 3	British Columbia, Canada	Eurocopter AS 350	major	1 minor/none
After dropping off skiers about 160 nm (296 km) northwest of Smithers, the helicopter encountered clouds and struck snow-covered terrain. The pilot released his seat belt and was ejected as the helicopter rolled down the mountain.				
Feb. 5	Sulaimaniya, Iraq	Hawker Beechcraft Hawker 850XP	total	7 fatal
The aircraft crashed after the right engine apparently failed during a night takeoff with 1,500 m (about 7/8 mi) visibility in snow and mist.				
Feb. 8	Fragagnano, Italy	Breda-Nardi 369 (MDD 500)	major	2 minor/none
The helicopter rolled over and floated inverted after it was ditched in a reservoir following a loss of power.				
Feb. 8	Robberg, South Africa	Pilatus PC-12	total	9 fatal
The aircraft crashed in Plettenberg Bay during a go-around in thick fog.				
Feb. 9	Kasabonika, Ontario, Canada	Beech 1900	major	15 minor/none
Winds were from 300 degrees at 10 kt, gusting to 18 kt, when the aircraft touched down on Runway 30, a gravel strip that was covered with packed snow and patches of ice. The 1900 veered off the left side of the runway, and the flight crew shut down the engines before it struck a snowbank.				
Feb. 10	Cork, Ireland	Fairchild (Swearingen) Metro	total	6 fatal, 6 serious
Visibility was 400 m (1/4 mi) and there was a broken ceiling at 100 ft when the Metro rolled inverted and crashed on the runway during an attempted go-around. The flight crew had conducted two previous ILS approaches and missed approaches.				
Feb. 12	Bintan Island, Indonesia	Indonesian Aerospace 212	total	5 fatal
The aircraft crashed during a reportedly unauthorized functional check flight following replacement of an engine.				
Feb. 13	Port-au-Prince, Haiti	BAE Systems Jetstream 31	total	21 minor/none
The flight crew was unable to extend the left main landing gear, and the aircraft veered off the left side of the runway during the landing roll.				
Feb. 14	Muhinga, Democratic Republic of Congo	Let 410 Turbolet	total	2 fatal
The aircraft struck a mountain shortly after departing from Kavumu for a cargo flight.				
Feb. 14	Las Mesitas, Honduras	Let 410 Turbolet	total	14 fatal
Visibility was reduced by fog when the aircraft struck terrain about 5 km (3 nm) from the runway during a nonprecision approach to Tegucigalpa.				
Feb. 14	Appleton, Wisconsin, U.S.	Gulfstream Aerospace G-550	major	3 minor/none
The aircraft was on a functional check flight when it overran a dry, 6,501-ft (1,982-m) runway on landing.				
Feb. 16	Medina, Saudi Arabia	Boeing 747	major	265 minor/none
The left main landing gear collapsed after the 747 veered off the runway during a night landing.				
Feb. 16	Grenchen, Switzerland	Cessna Citation CJ1	major	2 minor/none
The aircraft became airborne after overrunning the runway on takeoff and striking several obstructions. The pilots then diverted to Zurich for an uneventful emergency landing.				
Feb. 17	Valais, Switzerland	Eurocopter AS 350	total	4 serious, 2 minor/none
The helicopter crashed about 50 ft below its intended landing site while transporting skiers to a mountain glacier.				
Feb. 18	Rionegro, Colombia	Bell 206	total	4 fatal
Adverse weather conditions prevailed when the helicopter crashed in an area of high ground.				
Feb. 18	Pachuca, Mexico	Learjet 24	total	2 fatal
The Learjet crashed into a building after the pilots apparently lost control on approach.				
Feb. 21	Altamira, Brazil	ATR 72	major	52 minor/none
The aircraft veered off the runway after its left main landing gear collapsed on landing.				
Feb. 23	Jeju Island, South Korea	Agusta Westland 139	total	5 fatal
The helicopter crashed in the Yellow Sea about 93 km (50 nm) west of Jeju Island after picking up a patient from a coast guard vessel.				
Feb. 27	Al Ain, United Arab Emirates	Grumman Goose	total	4 fatal
The amphibious aircraft struck terrain during a night takeoff from a runway.				

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

Source: Ascend