AeroSafety WORLD

CLEARANCE CONFUSION
ILS without a glideslope

REINVENTING RESCUE
Upgrading ARFF

PHRASE OF FLIGHT
Standardizing aviation English

FLUID SITUATION
Anti-icing formulation reform

Managing Risks
REVIEWING THE FAA

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

NOVEMBER 2008

PERSISTENT Efforts

We certainly live in interesting times. The move from boom to bust in our industry has been spectacular. Aviation took a serious hit as oil prices spiked over US$140 a barrel, then, in just a few months, oil prices became yesterday's news. The next crisis was even worse, a shortage of cash and passengers. Only a few months ago, we had to consider how to manage safety during an overheated expansion. Now we have to consider how to help our industry stay safe as it restructures to survive the latest round of economic turbulence.

Now is the time to consider the safety threats and mitigations than can emerge during lean times. Clearly, cutbacks will occur throughout the industry, and it will be tempting to cut some corners in safety departments. One place that does not make sense to cut is safety management. For those of us who promote that science, it is time to sharpen our pencils and remind executives that an efficient operation and a safe operation are not two different things. Safety management allows us to identify problems when they are still small — and cheap. One of the early adopters of safety management was Air Transat. That airline realized a 72 percent reduction in abnormal operating costs because they became more aware of their operation. Safety management earns its place in an organization. Never let anyone forget that.

Another thing we can't put off, even during tough times, is end-to-end improvement of our training and selection systems. The easiest time to fix a system is when it is not clogged to capacity, and that time is now. As dark as things may seem today, it is important to remember that a recovery is inevitable. There still will be a structural demand for air transportation as 2 billion people lift themselves into the middle class over the next 20 years. We have learned the hard way that our training and selection systems collapse like a house of cards when challenged by growth. I heard many tales of woe around the world when a few Middle East airlines picked up fewer than 1,000 pilots; I can't imagine what it will look like when we have to produce tens of thousands of pilots year after year. There is work to be done on these issues, and now is the time to do it.

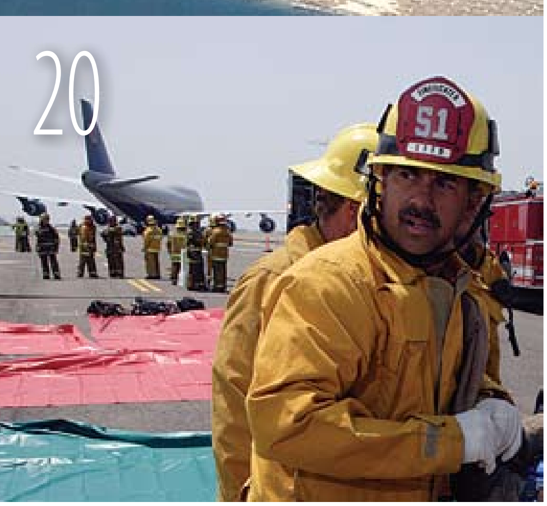
My last point is the one that troubles me the most, because I am not sure what to do about it. Safety professionals know that fatigue is a big human performance issue, but we don't know the effects of *weariness*. I am talking about what happens to a workforce that is battered by one crisis after another. I worry that safety will be compromised when professionalism is overridden by a sense of resignation. We ask people to stay focused, but that may not be a reasonable request every day. I hope you, as managers, will do whatever you can to insulate the operational professionals from the anxiety and distractions of this economic environment. I believe we have to start thinking about the weariness factor before it affects our safety record and our bottom lines.

William R. Voss
President and CEO
Flight Safety Foundation

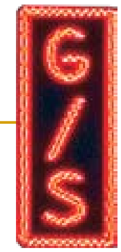
AeroSafetyWORLD

contents

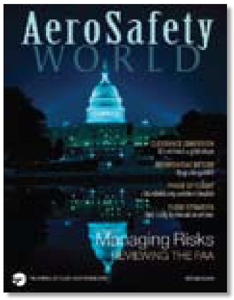
November2008 Vol 3 Issue 11



features



departments



About the Cover
The FAA asks for, and gets, an independent evaluation.
© Pgangler/Dreamstime.com

We Encourage Reprints (For permissions, go to <www.flightsafety.org/asw_home.html>)

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, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 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 — $280. Single issues are available for $30 for members, $45 for nonmembers. For more information, please contact the membership department, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA, +1 703.739.6700 or membership@flightsafety.org.

AeroSafetyWORLD

telephone: +1 703.739.6700

William R. Voss, publisher,
FSF president and CEO
voss@flightsafety.org

J.A. Donoghue, editor-in-chief,
FSF director of publications
donoghue@flightsafety.org, ext. 116

Mark Lacagnina, senior editor
lacagnina@flightsafety.org, ext. 114

Wayne Rosenkrans, senior editor
rosenkrans@flightsafety.org, ext. 115

Linda Werfelman, senior editor
werfelman@flightsafety.org, ext. 122

Rick Darby, associate editor
darby@flightsafety.org, ext. 113

Karen K. Ehrlich, web and print
production coordinator
ehrlich@flightsafety.org, ext. 117

Ann L. Mullikin, art director and designer
mullikin@flightsafety.org, ext. 120

Susan D. Reed, production specialist
reed@flightsafety.org, ext. 123

Patricia Setze, librarian
setze@flightsafety.org, ext. 103

Serving Aviation Safety Interests for More Than 60 Years

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

MemberGuide

Flight Safety Foundation
601 Madison St., Suite 300, Alexandria, VA, 22314-1756 USA
tel: +1 703.739.6700 fax: +1 703.739.6708

www.flightsafety.org

Member enrollment — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Seminar registration — ext. 101
Namratha Apparao, membership services coordinator — apparao@flightsafety.org

Seminar sponsorships — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

Exhibitor opportunities — ext. 105
Ann Hill, director, membership and development — hill@flightsafety.org

FSF awards programs — ext. 111
Feda Jamous, accountant — jamous@flightsafety.org

Technical product orders — ext. 111
Feda Jamous, accountant — jamous@flightsafety.org

Library services/seminar proceedings — ext. 103
Patricia Setze, librarian — setze@flightsafety.org

Web Site — ext. 117
Karen Ehrlich, web and print production coordinator — ehrlich@flightsafety.org

TROUBLING Retreat

We suddenly have become aware that attention must be paid to even the apparently most secure safety bastion. Before this week I readily would have identified American Airlines (AA) as a beacon of enlightened aviation safety thinking. But then we heard that American's management and the Allied Pilots Association union failed to renew the airline's Aviation Safety Action Program (ASAP) and it would stop operating.

"But," I said in disbelief to a colleague, "they *invented* ASAP."

Labor-management relations at American have traced a tortured arc. The "B scale" pay plan for new hires was born there in a burst of common-cause cooperation. It fed an AA growth spurt before becoming the poster child for poisonous labor relations. Then there were the post-9/11 pay cuts AA unions accepted, the unions' mood later turning when executive bonuses were revealed.

A friend of ours at American tells us, "In my opinion, both [parties] are at fault and neither side is willing to give an inch. That sums up the entire labor relations spectrum at AA today. I watched years ago as a strong, anti-management faction came into control of the APA. The pendulum swung back towards cooperation, and swung again last year with another anti-management group winning control."

Other airlines have toxic labor relations, but we always hope that safety issues can remain above the fray. Sometimes, apparently, the battle expands to include scorched earth tactics, with no prisoners taken.

Reports say that the ASAP for pilots has been part of the bargaining for many months. It was due to expire early this year, but the Federal Aviation Administration extended it to allow cooler heads to prevail. That didn't happen, and now the birthplace of one of the bedrock aviation safety reporting systems is without the program it created.

Reaction in AA's local Texas news media outlets to the failure of this ASAP has been negative: "Broadly speaking, the union tried to get new language that better protected pilots. Broadly speaking, management tried to get new language to not protect pilots that they didn't think should be protected," wrote Terry Maxon on the *Dallas Morning News* Web site. "The loser, of course, is everybody."

An APA communication to its members said, "You don't have ASAP because management … has lost the trust of its pilots."

A pilot in management said the failure was "sad and incomprehensible."

The Flight Safety Foundation position is summed up by FSF President and CEO Bill Voss: "The entire industry is facing difficult times and disputes are inevitable, but no one should ever allow safety to become a bargaining chip."

By the time this is read, all parties involved may have come to their senses. That, however, will not quiet our concern. This troubling retreat on the safety front is a warning shot signaling that we cannot simply walk away from a safety victory, dusting off our hands and congratulating each other on a job well done, looking ahead to new horizons, new companies and new cultures to bring into the safety reporting revolution. Attention must continue to be paid to nurturing these programs wherever aviation exists, from the glass executive towers of Fort Worth to the dusty control towers of the developing world.

J.A. Donoghue

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

NOV. 2–5 ➤ ATCA 53rd Annual Conference and Exposition. Air Traffic Control Association. Washington, D.C. Claire Rusk, <claire.rusk@atca.org>, <www.atca.org/annualconference.aspx>, +1 703.299.2430.

NOV. 3–6 ➤ Dangerous Goods Training Course for Civil Aviation Authorities Staff and Airport Authorities. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=169>, +31 (0)23 567.9790.

NOV. 4–9 ➤ Airshow China. Zhuhai Airshow Co. Zhuhai, Guangdong, China. <zhuhai@airshow.com.cn>, <www.airshow.com.cn>, +86 756.336.9235.

NOV. 10–12 ➤ ATAC 2008 Annual General Meeting & Trade Show. Air Transport Association of Canada. Calgary, Alberta. <atac@atac.ca>, <www.atac.ca/en/events/agm/index.html>, +1 613.233.7727.

NOV. 10–14 ➤ Annual Global Safety Seminar. Civil Air Navigation Services Organisation. Queenstown, New Zealand. Marc-Peter Pijper, <marcpeter.pijper@canso.org>, +31 (0)23 5685390. <www.canso.org/Canso/Web/events/canso+diary/Annual+Global+Safety+Seminar+2008.htm>.

NOV. 11–12 ➤ European Aviation Training Symposium (EATS): Exploring and Promoting European Best Practice in Aviation Training and Education. Halldale Media. Vienna, Austria. Chris Lehman, <chris@halldale.com>, <www.halldale.com/EATS.aspx>, +44 (0)1252 532000.

NOV. 11–12 ➤ Airline Safety, Quality and Technical Training Conference. Aviation Industry Conferences. Dubai, United Arab Emirates. Juliet Trew, <juliett@aviation-industry.com>, <http://206.18.175.32/ME2/Audiences>, +44 (0)207 931.7072.

NOV. 12–14 ➤ AAAE Runway Safety Summit. American Association of Airport Executives. Fort Lauderdale, Florida, U.S. Alex Gertsen, <alex.gertsen@aaae.org>, <www.aaae.org/products/meeting_details.html?Record_id=587>, +1 703.824.0500.

NOV. 13–14 ➤ Introduction to Accident and Incident Investigation. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=134>, +31 (0)23 567.9790.

NOV. 16–18 ➤ Airport Expo. Middle East Business Aviation. Dubai, United Arab Emirates. <www.meba.aero>, +971 4.286.7755 (Dubai), +44 (0) 208.391.0999 (U.K.).

NOV. 16–19 ➤ Advanced Airport Safety and Operations Specialist School. American Association of Airport Executives and U.S. Federal Aviation Administration. Miami. Brian Snyder, <brian.snyder@aaae.org>, <events.aaae.org/sites/080910/index.cfm>, +1 703.824.0500, ext. 174.

NOV. 17–18 ➤ Fatigue Risk Management Systems. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=218>, +31 (0)23 567.9790.

NOV. 17–21 ➤ SMS Principles. MITRE Aviation Institute. McLean, Virginia, U.S. Cheryl Andrews, <andrewsc@mitre.org>, <mai.mitrecaasd.org/sms_course>, +1 703.983.6275.

NOV. 18–19 ➤ Air Safety Work Group. European Regions Airline Association. Valencia, Spain. Martin Ambrose, <Martin.Ambrose@eraa.org>, <www.eraa.org/inside-era/eraevents.php>, +33 (0)240 135.410.

NOV. 18–19 ➤ ACI World Safety Seminar. Airports Council International. Beijing. Howard Baggott, <hbaggott@aci.aero>, <www.aci.aero/cda/aci_common/display/main/aci_content07_c.jsp?zn=aci&cp=1-4-7392_666_2__>, +41 22.717.8749.

NOV. 20–21 ➤ Asia Pacific Aviation Safety Seminar 2008. Association of Asia Pacific Airlines. Bali, Indonesia. <saanthi@aapa.org.my>, <www.aapairlines.org/Asia_Pacific_Aviation_Safety_Seminar_2008.aspx>, +603 2145 5600.

NOV. 24–29 ➤ Special African Regional Air Navigation Meeting. AviAssist Foundation. Durban, South Africa. <info@aviassist.org>, <www.aviassist.org/pages/website_pages.php?pgid=4>, +31 20 7143148/12.

DEC. 1-3 ➤ 5th Annual FAA International Aviation Safety Forum. U.S. Federal Aviation Administration. Washington, D.C. Victoria Frazier, <victoria.frazier@faa.gov>, <www.faa.gov/news/conferences_events/2008safetyforum>, +1 202.267.3781.

DEC. 3–5 ➤ Emergency Response Planning Workshop. European Joint Aviation Authorities. Hoofddorp, Netherlands. <www.training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=133>, +31 (0)23 567.9790.

DEC. 8–10 ➤ STAMINA Human Factors Maintenance Training Course. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=26>, +31 (0)23 567.9790.

DEC. 13–14 ➤ Advanced Airport Safety and Operations Specialist School. American Association of Airport Executives, Guam International Airport Authority and U.S. Federal Aviation Administration. Tamuning, Guam. Teakoe Coleman, <teakoe.coleman@aaae.org>, <events.aaae.org/sites/081005/index.cfm>, +1 703.824.0500, ext. 173.

DEC. 17–19 ➤ Airside Safety Training Course. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=209>, +31 (0)23 567.9790.

FEB. 9–12 ➤ 26th Annual International Aircraft Cabin Safety Symposium. Southern California Safety Institute. Torrance, California, U.S. <www.scsi-inc.com>.

FEB. 11–12 ➤ Asian Business Conference and Exhibition (ABACE). National Business Aviation Association. <info@abace>, <www.abace.aero>, +1 202.783.9000.

FEB. 17–19 ➤ Airside Safety Training Course. European Joint Aviation Authorities. Hoofddorp, Netherlands. <training@jaat.eu>, <www.jaa.nextgear.nl/courses.html?action=showdetails&courseid=209>, +31 (0)23 567.9790.

FEB. 22–24 ➤ Heli-Expo 2009. Helicopter Association International. Anaheim, California, U.S. <heliexpo@rotor.com>, <www.heliexpo.com>, +1 703.683.4646.

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

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

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

Safety News

FAA Criticized on Oversight Role

The U.S. Federal Aviation Administration (FAA) is relying too heavily on air carriers' oversight of outsourced maintenance repair stations, according to an audit by the U.S. Transportation Department's Office of Inspector General (OIG).

The audit, conducted at the request of the U.S. House of Representatives transportation committee, said that, to reduce operating costs, air carriers are increasingly likely to outsource their maintenance. When this is done, the maintenance repair station conducting the work becomes, for audit purposes, an extension of the carrier's maintenance organization, subject to monitoring by the FAA.

The FAA has certificated 4,159 domestic and 709 foreign repair stations to perform maintenance on U.S. aircraft. The nine major U.S. air carriers reviewed by the OIG for the audit used outsourced repair stations in 2007 to perform 71 percent of their heavy airframe maintenance checks, the audit report said. In 2003, that figure was 34 percent.

The audit report said that carriers' oversight procedures for outsourced maintenance are "not always sufficient."

"FAA and air carriers must continually improve their oversight of repair stations to ensure that safety measures keep pace with the changing nature of the industry," the audit report said. "Although FAA has taken important steps to move its safety oversight toward a risk-based system, the agency still faces challenges in determining where the most critical maintenance occurs and ensuring sufficient oversight."

In addition, the audit found that the FAA "did not have an adequate system for determining how much and where the most critical maintenance occurs, [did not] have a specific policy governing when certificate management inspectors should visit repair stations performing substantial maintenance, [did not] require inspectors to validate that repair stations have corrected deficiencies identified in air carrier audits, and [did not] have adequate controls to ensure that inspectors document inspection findings in the national database and review related findings by other inspectors."

The audit's recommendations included a call for the FAA to implement a system for determining when and where critical maintenance is

© Christian Lagereek/iStockphoto

performed, to ensure that FAA inspectors conduct inspections of maintenance providers and to ensure that air carriers provide the repair stations that they use "with clearer guidance on how to perform maintenance and inspections." The FAA already is addressing the issue with a rulemaking change "but needs to pursue interim actions to establish agreements between air carriers and repair stations on maintenance procedures," the audit said.

Croatian Aviation Safety Faulted

Croatia is not complying with safety standards established by the International Civil Aviation Organization (ICAO), the U.S. Federal Aviation Administration (FAA) said after an evaluation of safety provisions.

© Ricardo de Mattos/iStockphoto.com

The FAA, through its International Aviation Safety Assessment program, regularly evaluates civil aviation authorities in all countries with air carriers that operate — or might be authorized to operate — flights to the United States.

Following the review, the FAA gave Croatia a Category 2 rating, which means that the country either lacks the laws or regulations to oversee its air carriers in accordance with ICAO standards or that its civil aviation authority is deficient in at least one area, such as technical expertise or inspection procedures.

The Category 2 rating also means that Croatian air carriers cannot establish service to the United States. Croatia has told the FAA that it is working to establish a safety oversight system that will comply with ICAO standards and recommended practices.

Cowling Separations

Current preflight procedures to ensure that engine fan cowlings are latched properly may be inadequate, the U.S. National Transportation Safety Board (NTSB) says, citing its investigations of several recent incidents in which cowlings have separated during flight.

The most recent of four incidents cited by the NTSB involved a US Airways Bombardier CL-600-2B19, which lost part of the right engine upper fan cowling during flight at 11,000 ft. None of the 53 people in the airplane was injured in the incident; the airplane received minor damage.

In this incident, as well as the three others, the NTSB found that the latches on the cowling were not properly fastened after maintenance performed before the flights. In one case, the NTSB also cited a first officer's failure to follow the checklist during a walk-around inspection.

The NTSB described separations of engine fan cowlings as an ongoing problem and noted that records from Bombardier, Airbus, foreign investigations and the U.S. Federal Aviation Administration (FAA) showed that "since 1992, there have been 15 events involving Airbus [single aisle] model airplanes … ; another 26 engine fan [cowling] separations occurred on 17 different airplane models since 1992.

"In addition, [NTSB] queries to Bombardier revealed 33 domestic and foreign cases of engine fan [cowling] separations (including six cases in 2007 alone), dating back to January 2001."

The NTSB said that the cowling separations have continued to occur in Airbus airplanes and Bombardier CL-600s despite a 2003 FAA airworthiness directive and a number of service bulletins. However, the NTSB found that Airbus operators that required dual-inspection signoffs to confirm that maintenance personnel latched the cowlings had been successful in preventing accidents and incidents.

© Bombardier

The NTSB recommended that the FAA require operators of Airbus airplanes and Bombardier CL-600s to revise maintenance manual procedures and inspection documents to require dual-inspection signoffs to confirm that the cowlings have been latched after any maintenance that requires an engine fan cowling to be opened.

Other recommendations called for requiring maintenance personnel who work on these aircraft to inform flight crews if the cowlings have been opened before flight; requiring operators to provide guidance on conducting inspections; and determining the extent of the separation problem on all airplanes and, if it is widespread, requiring operators to institute dual-inspection signoffs after engine maintenance.

Original ASAP for Pilots Disbanded

Flight Safety Foundation President and CEO William R. Voss has expressed disappointment at the demise of the American Airlines Aviation Safety Action Program (ASAP) for pilots — one of the earliest airline safety reporting programs.

ASAP encourages pilots and other airline employees to report safety-related incidents confidentially and without fear that they might be penalized for their reporting. Pilot participation ended in mid-October, when the airline management and its pilot employees were unable to agree on provisions to continue.

Voss said that development of ASAP in 1994 made American Airlines a leader in aviation safety.

"Airlines around the world modeled their own internal reporting programs after ASAP," Voss said. "Flight Safety Foundation has publicly supported this program and others like it as an important tool to prevent accidents. We are alarmed that either side would allow this incredibly important safety program to fall victim to distrust between labor and management. We strongly urge both sides to return to the bargaining table to get this program back online.

"The entire industry is facing difficult times and disputes are inevitable, but no one should ever allow safety to become a bargaining chip."

© Dallas/Fort Worth International Airport

African Challenges

© Jeecis/Dreamstime.com

The International Civil Aviation Organization (ICAO) has completed a seminar and workshop that officials say has provided a foundation for a safer and more efficient air transport system across the continent.

"With completion of this first seminar and workshop, participating African states are in a much better position to successfully meet the very serious safety challenges that confront the region," said Roberto Kobeh González, president of the ICAO Council.

Participants from 19 African countries attended the two-week session in Addis Ababa, Ethiopia. The seminar and workshop were intended to enhance safety through greater cooperation among governments and members of the aviation community. The agenda included intensive discussions of safety management systems as a "predictive approach" to aviation safety, ICAO said.

The seminar coincided with the introduction of reduced vertical separation minimum (RVSM) airspace over Africa in a continuation of the worldwide implementation of RVSM. The move means that a minimum vertical separation of 1,000 ft is permitted for eligible aircraft between Flight Level (FL) 290 and FL 410; the previous minimum vertical separation requirement was 2,000 ft.

Parachuting Recommendations

The U.S. National Transportation Safety Board (NTSB) has issued a series of recommendations for parachute jump operators, including measures to strengthen requirements for maintenance and pilot training, and to require more effective safety restraints.

The NTSB action followed release of a special investigative report identifying recurring safety issues in jump operations. The NTSB developed the special report as a result of its investigation of the fatal July 2006 crash of a de Havilland DHC-6-100 during takeoff from Sullivan (Missouri, U.S.) Regional Airport for a skydiving flight.

© Mauro Bighin/Dreamstime.com

In Other News …

Regulations have taken effect in **Australia** requiring random alcohol and drug testing of 120,000 aviation workers; the new testing requirements will affect pilots, cabin crewmembers, maintenance technicians, flight instructors, fuelers, dispatchers, load controllers, baggage handlers and Civil Aviation Safety Authority staff members with airside duties. … In the aftermath of several stall-on-rotation incidents, including two fatal crashes, **Bombardier** has issued new training materials for operation of CRJ100/200/440 regional jets and CL600/850 corporate jets when icing conditions are present. The materials are on the Bombardier training Web site at <www.batraining.com>. … The number of fatal accidents involving European commercial air transport operations decreased to three in 2007, down from six in 2006, the **European Aviation Safety Agency** says.

Runway Status Lights

Runway status lights (*ASW*, 9/08, p. 46) will be installed over the next three years at 22 major U.S. airports in what U.S. Federal Aviation Administration (FAA) Acting Administrator Robert A. Sturgell says is a "big step for safety" in the effort to reduce runway incursions.

The FAA has awarded a three-year, US$131 million contract to Sensis Corp. of Syracuse, New York, U.S., to install the lights, which are designed to automatically warn pilots if it is unsafe to enter or taxi across a runway, or to take off.

The lights will be installed at airports that also will use airport surface detection equipment Model X (ASDE-X), which combines surface-movement radar and transponder sensors to provide airport tower air traffic controllers with display information on aircraft and vehicle ground positions. Enhanced versions of ASDE-X automatically alert controllers to imminent ground collisions. The runway status lights also will receive ASDE-X data.

Runway status light prototypes at international airports in Dallas and San Diego have been effective in averting runway conflicts, Sturgell said.

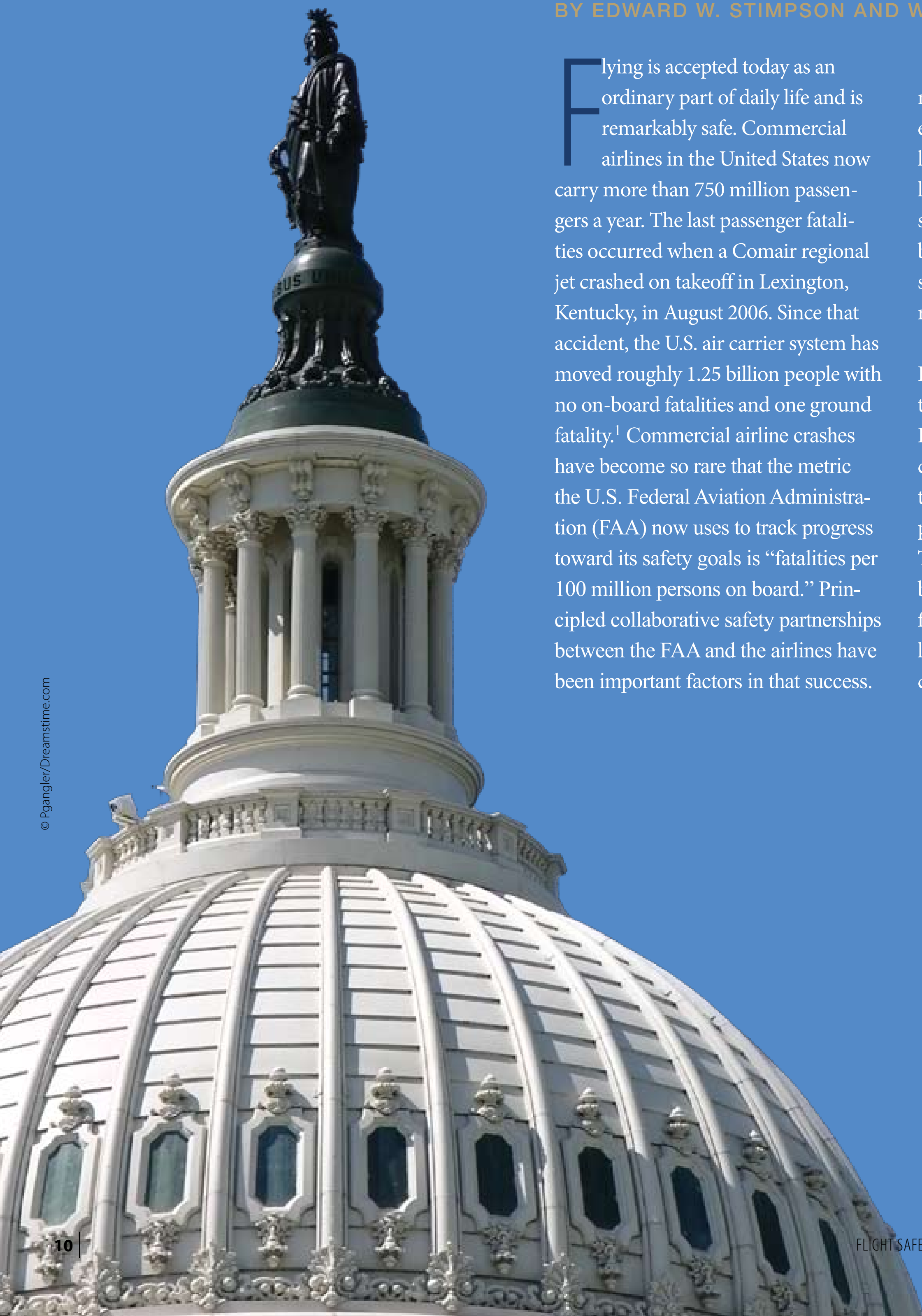
U.S. Federal Aviation Administration

Compiled and edited by Linda Werfelman.

Managing Risks in Civil Aviation

Two members of the Independent Review Team, created by the U.S. Department of Transportation, review the team's assessment of the FAA's approach to safety.

BY EDWARD W. STIMPSON AND WILLIAM O. MCCABE



© Pgangler/Dreamstime.com

Flying is accepted today as an ordinary part of daily life and is remarkably safe. Commercial airlines in the United States now carry more than 750 million passengers a year. The last passenger fatalities occurred when a Comair regional jet crashed on takeoff in Lexington, Kentucky, in August 2006. Since that accident, the U.S. air carrier system has moved roughly 1.25 billion people with no on-board fatalities and one ground fatality.[1] Commercial airline crashes have become so rare that the metric the U.S. Federal Aviation Administration (FAA) now uses to track progress toward its safety goals is "fatalities per 100 million persons on board." Principled collaborative safety partnerships between the FAA and the airlines have been important factors in that success.

Even while the accident rate remains at historic lows, a series of events earlier this year put the FAA very firmly in the public spotlight. These events led to inquiries from the U.S. Congress, significant news media attention and a broader questioning of the regulatory style and methods on which the FAA relies to keep the skies safe.

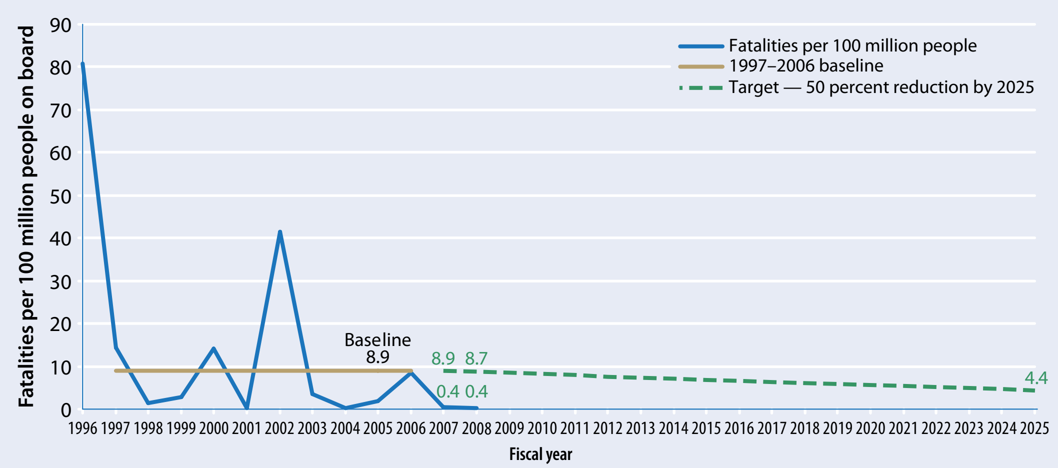
On April 3 and 4, 2008, the House Committee on Transportation and Infrastructure, chaired by Rep. James L. Oberstar (D-Minn.), conducted hearings on alleged safety issues at Southwest Airlines and possible lapses in FAA oversight. The committee's investigation, based on whistleblower complaints from FAA inspectors, explored allegations that Southwest, with FAA complicity, had allowed at least 117

of its planes to fly in violation of regulations. The central issue was whether the FAA had succumbed to excessively "cozy" relationships with the airlines, routinely failed to take proper enforcement action and allowed noncompliant airlines to escape penalties by using voluntary disclosure programs without fixing their underlying safety problems. Such a relationship is termed *regulatory capture*.

many to suggest that the FAA overreacted and that the grounding was unnecessary. The combination of these events, and the extraordinary coincidences in terms of timing, produced for the FAA a perfect storm. First, the agency was broadly accused and roundly condemned for having slipped into overly friendly relationships with industry. Then, within days, it was accused of acting harshly and legalistically, causing severe disruption and economic damage.

As a result, Transportation Secretary Mary E. Peters announced measures to improve the FAA's safety inspection program and to minimize travel disruptions caused when airlines abruptly ground aircraft. The secretary also formed the Independent Review Team (IRT) to examine the FAA's safety culture and its safety management.[2] She asked the team to recommend ways to help optimize the agency's effectiveness for airline safety. On the team with us were J. Randolph Babbitt, Professor Malcolm K. Sparrow and the Honorable Carl W. Vogt.

Air Carrier Fatal Accident Rates/Targets



Source: U.S. Federal Aviation Administration

Figure 1

In response to the congressional and public concern arising from the hearings, the FAA ordered an immediate nationwide audit of airline compliance with airworthiness directives (ADs). As a direct result of these "special emphasis" audits, problems quickly surfaced with American Airlines' fleet of McDonnell Douglas MD-80s. On April 8, faced with the prospect of an imminent enforcement action by the FAA, American grounded its entire fleet of MD-80s — more than 300 airplanes — returning them to service only after the AD requirements had been met to the FAA's satisfaction. American Airlines cancelled 3,100 flights over a four-day period, stranding or inconveniencing more than 250,000 passengers.

The grounding of American's MD-80s came only days after the congressional hearings into the Southwest *non*-grounding — which has led

During our 120-day review, we met with a broad range of stakeholders in the Department of Transportation (DOT), airlines and manufacturers, trade associations, labor unions, the U.S. Congress and others. We identified six areas for comment and proposed specific actionable recommendations in five of them (see "Recommendations," p. 12). Our 13 recommendations addressed ADs; voluntary disclosure programs; the culture of the FAA; safety management systems (SMS); and ATOS (Air Transportation Oversight System), information technology and the role of FAA inspectors.

Independent Review Team Recommendations

- The Federal Aviation Administration (FAA) should provide timely information about new airworthiness directive (AD) requirements in advance of compliance dates to all relevant FAA field offices. Those offices should then respond to any carrier that requests assistance in the form of "progress towards compliance" audits or reviews, in advance of the AD compliance dates.
- The FAA should retain the unambiguous right to ground any plane not in compliance with an applicable AD. Inspectors should not be required or expected to conduct any type of risk assessment before taking action on AD noncompliance.
- The FAA's voluntary safety reporting programs are vitally important to the future of aviation safety and should be retained.
- The FAA must abide by the rules constraining these programs in order to prevent the erosion of compliance.
- Voluntary disclosure reporting program data must be routinely analyzed at a higher level within the FAA to identify trends and patterns that represent risk and to guarantee the integrity of the programs.
- The number of voluntary disclosures made is a composite measure and should not be used either as a performance metric or as a risk factor in any context.
- To maintain the assurance of confidentiality, the FAA should resist any efforts to relax or eliminate restrictions on disclosure.
- The FAA should explicitly focus on wide internal divergences in regulatory ideologies, where they exist, as a source for potentially serious error.
- Training for managers and principal inspectors should explicitly cover the management of contrasting regulatory views within the workforce; methods for moderating extremes in regulatory style; and methods for optimizing the regulatory effectiveness and coherence across a diverse team of inspectors.
- The FAA should deploy the recently established Internal Assessment Capability (IAC) to review the composition and conduct of any offices or teams identified under the recommendation above.
- The FAA should deploy the IAC routinely to review the culture and conduct of any certificate management offices where the managerial team has remained intact for more than three years.
- The FAA should embrace its own operational role in risk identification and risk mitigation as formally and as energetically as it has approached the oversight of industry's safety management system implementation, and expedite its implementation planning.
- The FAA without delay should commission a time-and-motion study of its front-line inspection operation, to empirically assess the time demands of Air Transportation Oversight System (ATOS) and other information system implementations. Based on the results of such a study, agency leadership should establish clear expectations for what proportion of an inspector's work week that data entry, data analysis and other computer-related tasks should reasonably consume. It should monitor progress toward more reasonable ratios as ATOS and other information technology systems are improved over time.

Airworthiness Directives

Acting FAA Administrator Robert A. Sturgell has initiatives under way to improve the AD process, along with the quality and clarity of the ADs themselves. He commissioned a joint FAA-airline industry team to review the AD process, from drafting, review and integration of ADs, to their audit and compliance enforcement. Our team wholeheartedly supports those initiatives.

Nevertheless, we expect some disparity in AD interpretation to continue. To reduce this disparity, we proposed that the FAA provide to all relevant FAA field offices timely information about new AD requirements before their compliance dates. The field offices should then respond to any carrier that requests assistance in the form of "progress toward compliance" audits or reviews in advance of the AD compliance dates. This collaboration can benefit the airlines, the FAA and the traveling public by reducing the chances of major disruptions.

We believe it is vital for the FAA to retain an unambiguous right to ground *any* aircraft found to be out of compliance with *any* relevant AD without having to prove anything else at that moment. An aviation safety inspector should not be required or be expected to make safety-of-flight determinations or other risk assessments before taking enforcement action about AD noncompliance. Mandating the use of evaluative criteria would likely only undermine the FAA's ability to take effective enforcement action when necessary. Inspectors should be allowed to apply their professional judgment and discretion.

Voluntary Disclosure

Voluntary disclosure is a well-accepted component of any modern regulatory tool kit. U.S. airline accidents are now so infrequent that enhancing safety even further depends on identifying emerging risks as early precursors to an actual disaster. Most such events are known only to those directly involved and might otherwise remain hidden from the authorities. The three predominant programs are:

- Voluntary Disclosure Reporting Program (VDRP), used by airlines and other regulated entities;
- Aviation Safety Action Program (ASAP), used by 73 operators, with 169 programs for pilots, mechanics, flight attendants and dispatchers; and,
- Flight Operational Quality Assurance (FOQA), with participation by 20 airlines.

We reaffirmed the value of the FAA's voluntary disclosure programs as vital to continuing to improve safety. The programs are in line with modern regulatory practice and have suitably clear boundaries. We also reaffirmed how important it is for the FAA to comply with the guidelines and restrictions surrounding the voluntary disclosure programs to guarantee these programs' integrity and to prevent the erosion of industry's compliance incentives.

We were concerned about the potential misinterpretation of the variety of problems experienced and problems reported across airlines. It is misleading and dangerous to interpret variations in such metrics as either good or bad without systematic or scientific approaches to unbundling them. It is also important that participation in all of the voluntary disclosure programs depends on the assurance of confidentiality for information submitted. The FAA must protect that confidentiality for those programs to succeed.

FAA's Culture

We found the FAA's aviation safety staff to be clearly committed to their core safety mission. At the same time, we found remarkably varied regulatory ideologies among the staff. We believe agency leadership should pay particular attention to this issue and create intervention mechanisms to help guarantee coherence and rationality in regulatory practice. A case in point is identifying and dealing with potentially troubled certificate management offices (CMOs), where sharp conflicts of regulatory ideology may persist. The concentration should be on offices or teams where enforcement initiation is severely skewed across the inspection team. Finding such situations does not necessarily mean that the enforcement-generating minority is wrong or in need of correction. Nor does it mean that *anyone* is necessarily wrong; it just indicates a wide divergence in regulatory preferences, possibly affecting the consistency of the decision-making processes.

Because of this potential, we believe the FAA needs a method to review the overall regulatory functioning of CMOs, using teams of experienced managers drawn from other FAA offices. To accomplish this goal, the recently created Flight Standards Service Internal Assistance Capability (IAC) can be a good vehicle. The alignment of its design purpose with these types of office-based interventions could help address regulatory culture variations.

During his April congressional testimony, DOT Inspector General Calvin L. Scovel III suggested creating another independent office inside the FAA that reports directly to the administrator to receive and handle complaints about critical safety issues. While we considered this option, we believe such a structure now should be unnecessary, especially if the measures mentioned above can be used to identify and resolve clashes of regulatory ideology within FAA offices.

It also has been proposed to mandate rotation of CMO managers and/or supervisors on a three- or five-year basis. Despite the risk of regulatory capture that might be produced by longstanding relationships between regulators and regulated entities, we believe there is a strong countervailing value in building and maintaining a detailed knowledge of a specific airline's operations. The risks of coziness between the regulators and the regulated can be effectively mitigated through routinely scheduled IAC reviews of any offices in which the managerial team has remained intact for more than a preset number of years. This approach provides a more focused and diagnostic way of dealing with the regulatory

Independent Review Team: Babbitt, McCabe, Stimpson, Vogt, Eby and Sparrow

capture risk while avoiding the costs and disruption of mandated rotations.

Safety Management

We were encouraged by the general level of SMS understanding and implementation among the airlines we visited. Several SMS programs reflected a clear understanding of the various methods of hazard discovery and the need for formalized assessment, analysis and resolution of the risks. They further addressed the need for follow-through and methodological rigor to ensure continued mitigation of those risks.

In assessing the FAA's approach to SMS, we distinguished three contributions the FAA can make:

- Policy and rule making should rest on sound risk assessments and analysis. The agency has demonstrated a sound ability in this role;
- The FAA should specify requirements for SMSs to be constructed and operated by regulated entities, and then audit them for adequacy, effective operation and compliance; and,
- The agency should deal with risks that belong at the FAA level — those that require national or governmental attention — by establishing systems *within* the agency to identify and mitigate risks that transcend individual regulated entities, or that straddle multiple sectors of the industry.

We noted the agency will have trouble meeting the International Civil Aviation Organization's deadlines for designing and implementing SMS regulations by November 2009. However, the FAA's SMS program engages with airlines on a voluntary basis and in a healthy fashion, even in advance of any final rule. We are confident that the FAA, in its SMS oversight role, will help airlines less advanced in this area to catch up. The agency also should be able to overlay a more standardized framework on the miscellaneous approaches to SMS now being pursued across the industry.

We observed widespread confusion throughout the FAA regarding the nature of its own operational role under SMS. The FAA has demonstrated a capacity to conduct sophisticated analyses of policy issues and some high-profile risk concentrations. It is also developing certain technical capabilities that will be pivotal to this operational role, and it has begun to assemble the requisite analytic teams. However, the FAA has paid less attention to the organizational challenges in structuring this work. We do not believe the FAA is focused sufficiently on its ability to expand and develop its own operational risk management capabilities.

Oversight

The FAA aviation safety inspector workforce is talented, motivated and professional. However, inspectors' productivity and effectiveness are reduced by the number and diverse nature of the information systems involved in their work. In our interviews with inspectors in 15 FAA field offices, we found that ATOS was the primary subject of concern. It needs continued close attention to live up to its promise. We believe that further refinements of this system must be guided by a solid empirical understanding of how inspectors now spend their time.

Summation

We completed our IRT work on Sept. 10, 2008, when Peters accepted the report in its entirety and directed the FAA to implement all 13 IRT safety recommendations.[3] She said that the recommendations in the report "will improve both the intensity and the integrity of the FAA's safety program," and that the agency would begin implementing the recommendations immediately. She then noted, "Today, the Independent Review Team has delivered a blueprint that will assure continued safe skies ahead for America. It is my hope and expectation that this report will be cited as one of the reasons when, years from now, people ask why our skies have been so safe for so many for so long."[4]

Notes

1. Statistics were reported to the IRT by the FAA.
2. Available via the Internet at <www.dot.gov/affairs/dot5408.htm>.
3. The IRT report is available at <www.dot.gov/affairs/IRT_Report.pdf>.
4. Available via the Internet at <www.dot.gov/affairs/peters091008.htm>.

About the Independent Review Team Members

Edward W. Stimpson is chairman of the IRT, chairman of the FSF Board of Governors and former U.S. ambassador to ICAO.

J. Randolph Babbitt is a partner in the Aviation & Aerospace Section of Oliver Wyman, a global strategy consulting firm.

William O. McCabe is president of The McCabe Group, an aerospace consulting firm, and sits on the FSF Board of Governors.

Malcolm K. Sparrow is professor of the practice of public management at the Harvard Kennedy School of Government.

Hon. Carl W. Vogt, FSF chairman emeritus, is a former chairman of the U.S. National Transportation Safety Board and member of the White House Commission on Aviation Safety and Security.

Clifford C. Eby, deputy administrator of the U.S. Federal Railroad Administration, was staff director of the IRT.

PART TWO — COPING

Winter of Discontent

Anti-icing fluid issue challenges European stakeholders to look beyond competing interests.

BY WAYNE ROSENKRANS

Reformulations of problematic anti-icing fluids may not be available for five years, or possibly much longer, so European aircraft ground deicing/anti-icing reformers this winter are urging everyone concerned to make a concerted effort to reduce the risk that gels will form from water-soaked residues of anti-icing fluids, then freeze in flight. At stake are rare, but serious, airplane flight control restrictions (*ASW*, 10/08, p. 26) — for example, gel immobilizing control rods and bearings under aerodynamic fairings or filling the area between the elevator and elevator control tabs. Adequate progress also requires reconciling competing interests — including the preference of the majority of European airlines for certain fluids while regional airlines in the minority cope with unpredictable incidents, operational difficulties, and costly inspections and cleaning regimes that these fluids necessitate.

"The industry finds itself in a challenging position, and our main ambition is to influence those with the responsibility and authority to do the right thing," said Alistair Scott, chief airworthiness engineer and head of flight safety, BAE Systems Regional Aircraft, which has introduced design modifications to aid in aircraft deicing/anti-icing and maintenance, and has conducted a continual program of operator awareness. "Our TC holder responsibilities are somewhat limited in the ability to influence the safety of winter operations because the residue issue covers the operation of aircraft, the manufacture of fluid, and the regulation and approvals of companies that may or may not apply the fluid, and how [their services] are controlled."

A primary impediment to reform has been the innate drive by airlines to minimize the cost of winter operations and to maximize holdover capability, adds Kirsten Dyer, chairwoman of the SAE G12 Committee's Residue Workgroup and senior materials engineer for BAE Systems Regional Aircraft. "The big operators of the larger aircraft types are not having any problems with residues, and they like the one-step

U.S. National Aeronautics and Space Administration; fotosav/iStockphoto.com fluid application process as it is the cheapest method of giving them sufficient holdover to anti-ice all of their aircraft once in the morning. Large operators represent 80 percent of the fluid purchasing power, so they make the decisions."

Countermeasures generally have been effective. But in winter 2007-2008, one unidentified European regional airline that provides deicing/anti-icing services to other airlines experienced further incidents. "This operator was actually one of those more aware of this issue than others from purchasing and applying these fluids to aircraft — yet was still caught unawares," Dyer said. "[Despite a] cleaning and inspection regime that had been effective before, they had incidents between the cleaning and when the inspection regime kicked in. From what we understand, a new fluid adopted by this operator dried out faster than the previous fluid. That is a big danger — that a manufacturer could bring a new fluid onto the market that maybe has some property that causes an incident or worse."

"The flight safety people in airlines understand the issues, but some don't feel empowered to make decisions about the type of fluid used."

Type certificate holders typically cannot prescribe a universal, detailed cleaning and inspection program because of differences in operational environments and seasonal conditions, so a significant share of safety responsibility falls to operators. "The operator has to establish a frequency of inspection and check it periodically, depending on the types of fluids they have been using, the fluid-application process and the frequency of fluid use," Scott said. "If they don't want to clean the aircraft after every application, then they have to put a plan in place, and that requires some assessment. The flight safety people in airlines understand the issues, but [some] don't feel empowered to make decisions about the type of fluid used … the people who have that responsibility are elsewhere in the organization."[1]

EASA Response

The European Aviation Safety Agency (EASA) responded in September 2008 to 139 comments on its proposed tactics to address potential safety hazards related to anti-icing fluid residues. This evaluation of industry sentiment yielded insights into the difficulty of persuading affected organizations to update winter operations. Commenters included seven airlines, three deicing/anti-icing service providers, four professional associations, one standards organization, one airport, four aircraft manufacturers and five civil aviation authorities.[2]

For aircraft with non-hydraulically powered flight controls, the agency has called for type certificate holders to publish — in time for winter 2008-2009 — technical instructions recommending that operators use Type I deicing fluids rather than Type II anti-icing fluids and that they implement procedures for identifying and eliminating anti-icing fluid residues if Type II is used; that deicing/anti-icing service providers be licensed or certificated; and that residue-free anti-icing fluids be developed and certificated.

EASA agreed with some commenters who argued that the residue risk also should be addressed for aircraft with hydraulically powered flight controls. The agency proposed that all type certificate holders provide or improve instructions for operators and service providers, participate in work groups to revise fluid standards to include gel-formation potential, and review EASA's airplane certification specifications on this issue.

Boeing Commercial Airplanes considers deicing/anti-icing fluid residues to be an industrywide issue.[3] Airbus reminded EASA that the residue problem has not affected all airplane manufacturers/types. "Some aircraft have experienced many serious incidents due to residues, others have experienced very few or none," Airbus said. "This is the case with the Airbus fly-by-wire aircraft fitted with powered flight controls. Airbus aircraft fitted with powered flight controls have no adverse safety records related to the frozen rehydrated residues problem (e.g., control surface stiffness, control surface jamming, etc.)."

Unresolved issues in Europe include whether to institute regulatory approval of service providers; how to introduce standardization to diverse ground services provided by regulated airport operators and unregulated service providers, possibly by indirect regulation through airport operators; and whether airplane design modifications can compensate — without significant economic burden or added weight — for unpredictable factors such as service providers ignoring technical instructions by spraying anti-icing fluids from the rear of the aircraft into openings in the wing or other areas where flight control, hydraulic and electrical systems are located. Some civil aviation authorities argued that airworthiness directives — not revision of certification specifications — are the appropriate method of addressing residue effects on specific aircraft rather than investigating the susceptibility of all types of commercial transport aircraft.

Lack of choice of fluids at airports often was cited as a problem. "Most [commenters] would wish that [EASA] find ways so that an appropriate range and stock of thickened and unthickened fluids to anti-ice aircraft (i.e., each type of fluid should be available) is maintained and offered at each aerodrome receiving commercial air transport aircraft; deice/anti-ice service providers be approved; and fluids to deice and anti-ice aircraft [be] certified," EASA said, noting its current lack of jurisdiction in these areas.

The agency focused earlier this year on amending existing regulations to require operators to implement residue countermeasures via maintenance programs. If industry response is unsatisfactory or there is insufficient time to adequately address the issue by amending maintenance regulations, EASA may issue airworthiness directives for specific aircraft types before the end of 2008.

In the long term, EASA will monitor the issue and participate in industry working groups; consider the feasibility of amending aircraft certification standards to address flight control sensitivity to frozen gels; investigate and recommend methods for civil aviation authorities to deal with industry demands for service providers to be certified; include provisions in pending airport regulations to promote safer deicing/anti-icing practices, making available the types of fluids that operators need to manage their risk; consider amending pending air operations regulations to address the issue; and take steps toward rule making to extend jurisdiction from aircraft "parts and appliances" to fluids and materials.

Service Provider Issues

One service provider's comment to EASA summarized a perspective that other service providers have expressed to BAE Systems Regional Aircraft. "For an airline operating, say, three, four or maybe even five types of aircraft, the type-specific [deicing/anti-icing] training would not be a problem," Airline Services said. "For a service provider

Aircraft type certificate holders urge service providers to spray anti-icing fluid from the front toward the rear to reduce fluid penetration into aerodynamically quiet areas.

© Denis Roschlau/AirTeamImages.com

deicing in excess of 100 different types of aircraft, perhaps for 120 different operators — all with differing interpretations of the same requirement — this would be a problem of major proportions. A standard training program for each aspect of deicing is essential, with anything type-specific being covered in a training section titled 'Type Specific.' My company currently deices at 10 different airports. None of these have dictated or even suggested the fluids that we supply. Just so long as we comply with current health and safety and spillage regulations, then we are acceptable to them."

While such service providers say they are trying to reduce variation at any given airport, type certificate holders, operators and civil aviation authorities remain concerned about inconsistencies among airports in deicing/anti-icing. "Poor training in the application of the [anti-icing] fluids can significantly increase the amount of residues if the fluids are sprayed directly into aerodynamic fairings, or more fluid is applied than necessary," Dyer said. "Holdover and residues are connected — the more holdover expected [by the large aircraft operators], the more thickeners within the fluid and the more residue."

From the type certificate holder's viewpoint, best practices might be ignored by service providers. "There needs to be additional awareness of the importance of spraying the aircraft from the front, and knowing the areas where not to spray," Scott said. "They must not ever deice from the back of the aircraft, which forces fluid into all the gaps and aerodynamically quiet areas where it is just going to stay. Flying around Europe, I see deicing from the back time and time again." He cited the U.K. Civil Aviation Authority (CAA) as one of the European authorities pushing for better training this year to eliminate unsafe practices by service providers.[4]

Scott says flight crews depend on service providers' documentation, but sometimes it shows no record of anti-icing fluid being applied although airline personnel saw fluid applied. "The accuracy of recording the type of fluid applied, indeed the actual brand of fluid, and the processes is valuable when it comes to troubleshooting," Scott said. "After a few applications of different fluids, however, it becomes very hard to ascertain which particular fluid caused the [residue] problem. … To really get to the bottom of the problem, aircraft operators should review their quality management system to see if or how it records this information."

Futuristic Fluids

Reformers and EASA encourage fluid manufacturers to reformulate today's anti-icing fluid as soon as possible. The best the operators can do for now, the reformers say, is to consider independent research alongside technical information obtained directly from the fluid manufacturers and operators' own winter experience.

"The residue workgroup's consensus is that all of the [anti-icing] fluids use a similar chemistry and have the potential to form residues," Dyer said. "However, some aircraft types appear to be more susceptible to the issue and some fluids are thought to have 'worse' residue properties. I obtained agreement in the workgroup this year in terms of future required testing, but there is unlikely to be consensus on whether the results can be used to classify the fluids for performance — which is the desired outcome — due to commercial interests." The work group includes some of the fluid manufacturers.

The latest independent research was conducted by the Anti-icing Materials International Laboratory (AMIL) at the University of Quebec at Chicoutimi in Canada with sponsorship of some work by the U.K. CAA.[5] AMIL's December 2007 report was designed to help operators understand, in general terms, the significant differences when specific brands of Type II, Type III and Type IV anti-icing fluids were applied to a vertical aluminum plate representing an external vertical panel on an aircraft.[6]

Eight fluid manufacturers and 21 of their fluid brand names are deidentified on the published AMIL chart, but a separate list makes it possible for the participating manufacturers to be contacted about gel-formation potential. "Posting the results on the AMIL site with the fluids unnamed and such a complex document is a first step … the best that we could do," Dyer said.

Airworthiness authorities, including EASA, cannot compel publication of trade secrets by the fluid manufacturers, and they prefer other approaches. "The process, to be effective, must recognize and accommodate the confidentiality of proprietary information," the agency said, calling safety information notices by regulators the preferred solution.

The AMIL report notes that its data alone are insufficient for selecting fluids or predicting residue effects. "If the characteristics are known to airlines/deicing providers, it would allow them to buy the 'best' fluids and would therefore encourage fluid manufacturers to develop better fluids," Airbus said in comments to EASA. "The simplistic SAE G12 [Committee–AMIL] test for fluid residue formation is known to be imperfect, but the results are useful nevertheless."

Dyer hopes that fluid manufacturers' research and development programs soon will yield the first residue-free anti-icing fluids — candidate fluids that also would help SAE International to revise existing standards. "Some manufacturers whose fluids do not have an acceptable residue performance may develop new fluids with a better residue performance," she told EASA. "It has to be remembered, though, that this has to be balanced with the holdover performance, environmental impact, cost and ease of application."

New environmental regulations that are sure to force fluid reformulations are expected within the next year or two — resulting from a U.S. Environmental Protection Agency initiative on waste water at airports and the Airport Cooperative Research Program — so no new fluids will be introduced until these guidelines are issued, Dyer said. Given this context, she is concerned that eliminating residue may not end up among the fluid manufacturers' main priorities.

The conundrum for fluid dynamicists, however, is that ingredients responsible for desirable properties of anti-icing fluids — especially safe aerodynamic flow-off during takeoff — are linked to residues. "This is a long-term solution," Dyer said. "The tests in the current SAE Aerospace Materials Specification (AMS) 1428 [Aircraft Deicing/Anti-icing Fluids] prevent the use of different thickener technologies that do not form residues. Current fluids either have a low residue formation but then a higher gel formation, so they rehydrate quickly and form heavy gels that can fall off [external areas]; or they rehydrate slowly but then don't have sufficient weight to help the gels fall off.

"If researchers develop a new fluid that doesn't cause residue, then because of the chemistry of the fluids, chances are that it won't meet at least some of the parts of AMS 1428. The specification and approval of the new fluid for use on aircraft basically then would become a new SAE G12 Committee task — probably developing a new specification, which is potentially longwinded and not easy."

By mid-2008, some fluid manufacturers had expressed to the residue workgroup willingness to disclose proprietary information about residues, Dyer said. The workgroup has proposed to reduce from 13 to five the number of residue-related factors to be tested in a new standard. "The intention is for fluid manufacturers to agree that new AMIL tests will be used as the objective comparison, possibly allowing the fluids to be classified without keeping any of the fluids from being available on the market," she said. An airframe manufacturer/type certificate holder in turn would be able to tell operators that a specific brand/type of anti-icing fluid is not acceptable on its aircraft.

Despite its limitations, AMIL testing is helping to replace industry myths with facts. For example, the research has shown that gels can form and freeze in aerodynamically quiet areas regardless of whether anti-icing fluids are applied undiluted or diluted, and regardless of whether Type II or Type IV anti-icing fluids are applied.

Notes

1. Association of European Airlines. *Training Recommendations and Background Information for De-Icing/Anti-Icing of Aircraft on the Ground, 5th Edition.* September 2008.
2. EASA. "Comment Response Document to Advance-Notice of Proposed Amendment (NPA) 200711 on Possible Course of Action for EASA to Address the Residues That Can Result From Application of Deicing/Anti-icing Fluids." Sept. 2, 2008.
3. Hille, Joel. "Deicing and Anti-icing Fluid Residues." *Aero,* p. 15. <boeing.com/commercial/aeromagazine>. First quarter, 2007. "[During winter 2005-2006] in Europe, restricted elevator movement interrupted the flight of two MD-80 airplanes," Boeing said. "In both cases, frozen contamination, a gel with a high freezing point, caused the restricted movement. The gel was Type IV fluid residue that rehydrated during takeoff or climbout in rain."
4. U.K. CAA Safety Regulation Group. "Training for Ground Deicing and Anti-icing of Aircraft." Flight Operations Division Communication no. 31/2008. Aug. 18, 2008.
5. AMIL. "Anti-icing Fluids Gel Residue Testing Results." Dec. 12, 2007. <www.uqac.ca/amil/en/gel-residues/web-gel-residues-type.pdf>
6. According to the AMIL report, its charts "depict the weight of [rehydrated] gel residue remaining on a clean, non-coated, vertical aluminum plate that has been dipped in anti-icing fluid and subjected to successive dry-out and hydration cycles." Fluid manufacturers were ABAX Industries-SPCA, Aviation Xi'an High-Tech Physical Chemical Co., Clariant Produkte (Deutscheland), Dow Chemical Co., Kilfrost, Lyondell Chemical Co, Newave Aerochemical Technology and Octagon Process.


© Chris Sorensen Photography

Sparse alternatives to self-evacuation push the ARFF community to expand lifesaving capability.

RESCUE ME

BY WAYNE ROSENKRANS

Controversy has smoldered for decades around the question of what constitutes adequate personnel, equipment, procedures, training and emergency response planning to prepare aircraft rescue and fire fighting (ARFF) services to rescue aircraft occupants after a survivable accident involving one or more large commercial jets.[1]

Technology has placed enormous extinguishing power, speed and precision in the individual firefighter's hands, and also has opened opportunities to reinvent rescue capabilities. It remains to be seen, however, whether societies will be open to paying for envisioned safety enhancements amid signs of a global economic downturn. Some airports historically have seen new ARFF requirements as threats to their commercial viability.

On the ARFF specialists' side are stakeholders who, for more than a decade, have pressed governments for a rescue-oriented overhaul of existing regulations. A 2008 U.S. example was lobbying by the International Association of Fire Fighters (IAFF) for a federal law requiring the Federal Aviation Administration (FAA) to update ARFF standards in the Federal Aviation Regulations (FARs). This provision, however, was removed from a bill considered in the Congress.[2]

New Rescue Tactics

The pilot-in-command is the highest authority for the decision to order an evacuation, but if the airplane crew appears unable to initiate an evacuation after an attempt by the ARFF incident commander to convey information about imminent fire danger, the firefighters typically will operate emergency door release mechanisms from the outside and possibly provide interior access vehicles, or a conventional elevated platform or passenger airstairs.

If fire or threat of fire already is present, the ARFF personnel will protect evacuees primarily by creating a foam blanket covering a rectangular area that is proportional to the length of the airplane, and by applying extinguishing agents to prevent fire from extending into the fuselage. If the ARFF incident commander also orders a rescue operation, hand-held hose lines — often called *handlines* — that discharge foam or water streams will be used to protect evacuees and ARFF personnel, to extinguish new fires and to maintain the foam blanket to suppress any fuel-fed fire.

Guidance material developed by the U.S. National Fire Protection Association (NFPA) contains a few examples of best practices for such rescues — with a caveat. "Interior aircraft fire situations can differ widely; therefore, explicit guidance regarding extinguishment techniques is not possible," the association said. "One rescue team method consists of four ARFF personnel equipped with full personal protective equipment and self-contained breathing apparatus. Two of the [firefighters] are handline operators and

Los Angeles Fire Department firefighters practice moving a survivor during LAX Air Exercise 2007, a full-scale simulated fatal crash of a Boeing 747 designed to test Los Angeles International Airport's emergency response plan.

precede the other two, who are equipped with appropriate hand-held tools needed for forcible entry, extrication and access to hidden fuselage fires behind panels, floors and compartments. A procedure preferred by some fire departments is to provide an additional handline operator, similarly attired and equipped with self-contained breathing apparatus, operating behind the rescue team with a spray stream as their protection throughout the entire operation."[3]

Direct interior fire attack with water streams becomes imperative any time fire breaches an intact fuselage (Table 1, p. 24). This is a critical moment, one in which decisions may differ among ARFF incident commanders — especially ordering entry by firefighters or piercing the fuselage with a high-reach extendable turret and skin-piercing nozzle to inject water while occupants are evacuating and/or firefighters are entering.

"For an interior fire, a vehicle equipped with a high-reach extendable turret … and a fuselage-piercing nozzle can apply a water spray right into the cabin," said Keith Bagot, the FAA's ARFF research and development project leader. "The ARFF vehicle can pull directly up to the plane and deploy its turret immediately. High-reach extendable turret technology is now installed on over 650 ARFF vehicles around the world."[4] On an FAA ARFF research vehicle, for example, the boom reaches 65 ft (20 m), 15 ft (4.6 m) farther than a previous model, to suppress a fire inside airplanes, including anywhere on the upper deck of the Airbus A380 or Boeing 747.

Water injection to cool a hot cabin interior, however, has yet to be attempted for an actual passenger aircraft fire.

The tactic has been used effectively for some freighter fires after the occupants evacuated. The concern within the ARFF community — expressed by attendees at a U.S. workshop on freighter fires (*ASW*, 01/08, p. 36) — is the possibility of steam-inhalation injury causing deaths among the survivors.

The arrival of any airplane with uncontrolled in-flight fire also can be extremely challenging for ARFF personnel. Complications include near-simultaneous demands for protecting an immediate evacuation and interior fire fighting without time to wait for the self-evacuations to finish.

"Entry [by ARFF firefighters also] will permit an inrush of fresh air into a possibly overheated or unstable atmosphere that could rapidly accelerate the fire," the NFPA said. "Toxic gases will be present, so ventilation and a thorough search for survivors should take place immediately and simultaneously with the fire-fighting effort."

Because trapped occupants may be encountered, rescue teams keep close at hand an arsenal of rescue saws, pneumatic chisels, hydraulically powered spreaders, high-pressure smoke-evacuation fans and other equipment such as compressed air bags that can shift the position of an unstable aircraft or provide shoring in a safe attitude.

Contentious Issues

One rescue-related point of contention between firefighters and the FAA is the "two-in, two-out" policy in the respiratory protection standard of the U.S. Occupational Health and Safety Administration (OSHA). Applying the policy would create a need for more firefighters on duty.

"This standard requires that firefighters engaged in fighting interior structural fires work in a buddy system that requires at least two workers in the structure and at least two workers outside in case a rescue of the firefighters is needed," the FAA said. "In a legal memorandum developed jointly by the FAA and OSHA … it was determined that the respiratory standard is applicable only to personnel fighting a fire within a structure and not an outside-aircraft fire. As the primary purpose of ARFF personnel is to suppress the external aircraft fire and establish an escape route for the crew and passengers, the 'two-in, two-out' rule does not apply to ARFF."

The U.S. Department of Defense adopts many NFPA and OSHA standards, however, including the two-in, two-out rule for its ARFF personnel.[5]

Small Airport Rescues

The FAA issued a final rule, effective in June 2004, to expand certification requirements to 37 previously non-certificated airports serving scheduled air carriers.[6] This was done by amending the FARs for airports in Part 139 and those for air carrier operations in Part 121. As a result, new requirements were applied to airports serving scheduled air carrier operations in aircraft designed for more than nine passenger seats but fewer than 31 passenger seats.

"Part 139 does not limit the airport operator from providing more ARFF coverage than required," the agency said in its final rule. "The firefighter and pilot labor organizations believe the [rule] did not go far enough. … The FAA agrees that some Part 139 ARFF standards may need revisions. The Aviation Rulemaking Advisory Committee has created an ARFF Working Group to review Part 139 ARFF standards and to propose new regulatory language, as appropriate." In late 2008, the FAA Web site added, "As this work is ongoing, the FAA has decided to wait to comprehensively update all ARFF standards."

A coalition of industry organizations other than airports and airlines in the late 1990s said, "Current [FARs] do not provide for firefighters to rescue passengers or extinguish fires inside an airplane."[7] The Air Line Pilots Association, International in 2000 elaborated on this with respect to new large transport aircraft: "The trend in the near future appears to be that the largest airplanes will have greater passenger loads distributed among two decks. This will necessitate that more passenger area remain survivable, however; it will also demand that fire fighting services are able to extinguish fires deep within a damaged fuselage structure."[8]

The FAA's ongoing work on ARFF standards likely will address concerns of the U.S. National Transportation Safety Board (NTSB), which in 2001 repeated, "The Safety Board concludes that ARFF units may not be staffed at a level that enables ARFF personnel, upon arrival at an accident scene, to conduct exterior fire fighting activities, an interior fire suppression attack and a rescue mission."[9]

The International Civil Aviation Organization (ICAO), too, has been pursuing — through a working group of the Aerodromes Panel — "some fine-tuning" of guidance material to amend the ARFF standards and recommended practices published in 1990, and amended in 1995. In a recent meeting, however, the working group considered the ICAO *Airport Services Manual, Part 1, Rescue and Fire Fighting* to be sufficient guidance material for civil aviation authorities.[10]

Rescue Experts

The FAA and ICAO both participate on the NFPA's Technical Committee on Aircraft Rescue and Fire Fighting. FAA and ICAO ARFF specialists are familiar with, and helped create, the new way of thinking about rescue that is reflected in the NFPA's 2008–2009 standards and guidance. The technical committee's perspective begins with the premise that, although protecting aircraft occupants has the highest priority, fire control many times is what makes survival possible for aircraft occupants.

This year, the NFPA's standard for ARFF services, first published in 1949, introduced a new definition of *aircraft rescue*: "Action taken to save or set free persons involved in an aircraft incident/accident by safeguarding the integrity of the aircraft fuselage from an external/internal fire, to support self-evacuation, and to undertake the removal of injured and trapped persons." Previous ARFF concepts did not distinguish so clearly the protection of escape paths for evacuees from the rescue of those who cannot self-evacuate.[11]

Technical committee specialists have forecast increased rescues of crash survivors because of worldwide fleet improvements such as aircraft design for crashworthiness, more robust passenger seats/restraints, combustion-resistant cabin furnishings, emergency escape-path marking and improved exit mechanisms, as well as crew training.

"If these design improvements are as successful as anticipated, the prompt and effective intervention by trained ARFF personnel becomes even more important [beyond 2008] because a greater number of aircraft accident survivors needing assistance can be expected," says the NFPA's current guidance on ARFF operations.[12]

The guidance emphasizes that an intact airframe typically provides no more than three minutes of survivable interior atmosphere during an exterior fuel fire, and that fuel-fed flames will cause burnthrough of aluminum skin in 60 seconds on typical commercial transport airplanes, although the time will be significantly longer for aluminum airplanes that have the latest fire-resistant thermal acoustic insulation (*ASW,* 4/08, p. 37) or fiber composite skins with fire-hardened windows (*ASW,* 9/08, p. 40).

"The analysis of aircraft accidents involving external fuel fires has shown that although external fires are effectively extinguished, secondary fires within the aircraft fuselage are difficult to control with existing equipment and procedures," adds Joseph Wright, an NFPA technical committee member. "Analysis of more recent aircraft accident data shows that fire services today are more likely to be responding to a complex accident with a moderate pool fire accompanied [by] a three-dimensional running fuel fire and an interior fire. … Firefighters put themselves at great personal risk when attempting [to extinguish] any interior fire with hand-held attack lines."[13]

The NFPA standards have introduced a comprehensive process called task and resource analysis, combining

Technologies available include, from left, the hydraulically powered spreader, ax, airstair-based interior access vehicle, rescue saw and high-reach extendable turret with aluminum skin-piercing nozzle.

Examples of Survivable Airplane Accidents Influencing ARFF Rescue Capability

Date	Location	Aircraft Type	ARFF Response[1]	Evacuated/ Rescued[2]	On-Board Fatalities
Aug. 27, 2006	Lexington, Kentucky, U.S.	Bombardier CL-600	11 M, 3 AP, 2 AV	0, 1	49
A public safety officer — cross-trained as a police officer, firefighter and emergency medical technician — arrived at the cockpit wreckage about 5.5 minutes after the crash alarm and was assisted by a police officer in rescuing the first officer, who had life-threatening, blunt force injuries. The entire cabin interior was on fire. About 11 minutes after the crash alarm, two ARFF trucks, each staffed by one firefighter, arrived and began applying extinguishing agent. The fire was controlled in three minutes by these trucks using one high-flow turret, one bumper turret, handlines and a high-reach extendable turret. The captain had been killed by nonsurvivable blunt force injuries. The flight attendant and several passengers in the forward cabin area had a "relative lack" of blunt force injuries and smoke inhalation. Several passengers seated in the aft cabin also had some blunt force injuries, and most showed evidence of smoke inhalation. These two groups of forward and aft cabin fatalities had survived the impact for an undetermined length of time; all were found close to their seats.					
Aug. 2, 2005	Toronto	Airbus A340	1 M, 15 AP, 8 AV	309, 0	0
All passengers and crew evacuated within about two minutes despite rapidly increasing smoke and the fact that four of eight exits were unusable or unsafe, the TSB said. Two crewmembers and 10 passengers sustained blunt force injuries during impact and/or serious injuries during evacuation. One passenger required ARFF assistance to move away from the exterior of the burning airplane because of a leg fracture. Firefighters entered the airplane via the front door and searched the flight deck and the first six rows of passenger seats for survivors before complying with the ARFF incident commander's order to evacuate because of danger from the explosions that were occurring. About one hour 39 minutes after the crash, ARFF personnel had accounted for 297 passengers and had received a manifest to confirm total passengers on board. The normal minimum ARFF personnel on duty was 11 people. The ARFF crews expended an initial quantity of water from their vehicles that was 65 percent greater than required by applicable regulations; additional water then was transported to the crash site to extinguish the fire.					
June 1, 1999	Little Rock, Arkansas, U.S.	McDonnell Douglas MD-82	17 M, 4 AP, 3 AV	134, NR[3]	11
Two flight attendants on the forward jump seats were unable to assist in the evacuation because of serious injuries. The ARFF response occurred in "blinding rain and wind" and involved delays finding and reaching the crash site. NTSB said, "The passenger in 27E [who had potentially survivable injuries but died in the cabin] remained on the airplane and therefore needed to be rescued from the wreckage. However, the four ARFF personnel that responded to the accident were not available to enter the airplane because they were involved in positioning the fire trucks and operating the fire-suppression equipment. Thus, an interior search of the aircraft could not be conducted until off-airport firefighters arrived on scene about 0022 [about 31 minutes after the crash]." The first officer could not evacuate the airplane on his own because his left leg was fractured. ARFF responders cut through metal and stepped on the center pedestal to extricate him from the flight deck wreckage. Firefighters also rescued some survivors from the first class section. The incident commander told NTSB that the first priority of ARFF personnel is fire control to provide an escape path and that after the fire is controlled, ARFF personnel assume rescue responsibilities and search the airplane interior for survivors. After the accident, six more ARFF personnel were hired and minimum on-duty personnel was increased to six.					
Nov. 19, 1996	Quincy, Illinois, U.S.	Beech 1900C and Beech King Air A90	14 M, 7 AP, 4 AV	0, 0	14
The impact forces were at a survivable level for the occupants of both airplanes when the 1900C collided with the King Air. Three nearby pilots were the first to reach the site, where both airplanes were on fire about 1,800 ft (549 m) from an unstaffed ARFF truck. The speed of fire precluded any rescue of the King Air occupants. The 1900's captain survived the collision and spoke to the would-be rescuers through an open cockpit window, but they could not open the forward airstair door and she died with all the other occupants. "If properly staffed, that truck should have been able to reach the accident site in no more than one minute," the NTSB said. "Firefighters might then have been able to extinguish or control the fire, thereby extending the survival time for at least some of the occupants of the Beech 1900C." Only off-airport firefighters were on duty at the time of the accident, consistent with airport certification regulations at the time. After arrival, they brought the fires under control within 10 minutes.					
Feb. 1, 1991	Los Angeles, California, U.S.	Boeing 737 and Fairchild Metroliner	1 M, 10 AP, 4 AV	65, 1	34
After the landing 737 collided with the Metroliner in position for takeoff, four ARFF units extinguished most of the pool fire under the 737 fuselage in about one minute and assisted the last six or seven surviving 737 occupants as they evacuated. Although not recognized immediately, the Metroliner had been crushed under the 737 with no survivors. Three firefighters then left their vehicles and began interior rescue operations in the 737, including extricating the first officer through a cockpit window. The captain was trapped by the wreckage and "appeared lifeless." The fire intensified rapidly and burned through the cabin roof. Several firefighters attacked the cabin fire with handlines through the R1 door, entered and remained in the cabin until the fire was extinguished. Their efforts included discharging 600 lb (272 kg) of Halon 1301 without effective suppression, and they were unable to advance more than a few seat rows because of the fire intensity. The NTSB said, "The rapid availability of adequate numbers of ARFF-trained firefighters … allowed ARFF personnel to implement an interior fire attack immediately."					

ARFF = Aircraft rescue and fire fighting; M = minutes; FAA = U.S. Federal Aviation Administration; AP = ARFF personnel; AV = ARFF vehicles; NR = Not reported; NTSB = U.S. National Transportation Safety Board; TSB = Transportation Safety Board of Canada

Notes

1. Actual response time, initial number of firefighters and initial number of ARFF vehicles responding from the airport's ARFF service.
2. Number of airplane occupants evacuated, including evacuations assisted by firefighters, and number of occupants who could not self-evacuate and had to be rescued by ARFF personnel or other first responders.
3. The 134 evacuees include an unspecified number reported as rescued by ARFF personnel.

Sources: NTSB, TSB

Table 1

qualitative analysis with quantitative risk assessment. Unlike the FAA and some other regulators, the NFPA has published a table of mandatory minimum total ARFF personnel — from two to 15 people — to be on duty to respond to the crash alarm based solely on the airport category, which is derived from calculation of minimum response times and the quantities and rates of extinguishing agent discharge. The task and resource analysis provides a structured method for airports and their ARFF services to determine how many additional firefighters, beyond generic minimums, should be on duty based on specific local conditions and risk factors.

Criticality of rescue also has led the NFPA to call for the availability of no fewer than two vehicles that simultaneously can conduct the fire attack and handle rescue-related contingencies.

In the 2008–2009 guidance material, the equation for calculating the minimum water quantity to be carried to the accident site by ARFF vehicles includes, for the first time, a variable representing water for handlines used for containment and extinguishment of fire during aircraft interior operations.

Exceeding Minimums

Many U.S. airports serving scheduled airlines exceed the minimum ARFF requirements of the FARs and/or the NFPA minimum standards. A 2008 survey by Airports Council International–North America (ACI–NA) noted, however, that this means ARFF departments vary widely in size and capabilities. "Of the [47] airports that responded, the largest ARFF department included 200 personnel while the smallest department employs just three personnel. There was also a great range in the number of minimum daily on-duty staffing; the largest department had a minimum staff requirement of 42 individuals, and the smallest reported a minimum staff requirement of just one officer."[14]

The survey showed that at the airports handling an average of five operations a day by air carrier airplanes 200 ft (61 m) in length or longer, the average minimum on-duty staffing was about 20 people, and the average reported total ARFF personnel was about 84 people. For airports handling an average of five operations a day by air carrier airplanes less than 90 ft (27 m) in length, the average minimum on-duty staffing was about two people, and the average reported total ARFF personnel was about 12 people.

"The overall average of reported staffing would be between one and two [ARFF] personnel per vehicle," ACI–NA said. "Currently, only eight [respondent airports] have an interior access vehicle, the most common vehicle noted in the survey being airstairs."

Advanced ARFF vehicles change the rescue possibilities with global positioning system–based navigation with moving map displays and ARFF vehicle position, ground radar transponders and forward-looking infrared (FLIR) video camera systems.

Airports that opt to conform to NFPA standards must consider providing a rescue truck dedicated to carrying rescue equipment suitable for conditions found at airports used by operators of relatively large representative aircraft such as the Airbus A300/A340-300/A380-800 and the Boeing 757/767-300/747-200.

Notes

1. The NTSB defines a *survivable accident* as "an accident in which the forces transmitted to the occupant(s) through the seat and restraint system do not exceed the limits of human tolerance to abrupt accelerations and in which the structure of the occupants' immediate environment remains substantially intact to the extent that a livable volume is provided for the occupants through the crash sequence."
2. IAFF. "Dangerous Airport Fire/Rescue Standards Jeopardize Lives, Fire Fighters Say." News release, April 30, 2008.
3. NFPA. "NFPA 402: Guide for Aircraft Rescue and Fire-Fighting Operations, 2008 Edition." June 24, 2007.
4. FAA. "Fire and Rescue: The Emergence of Aircraft Rescue and Fire Fighting Technologies." *R&D Review,* Issue 2, 2007.
5. DOD. Instruction 6055.06. "DOD Fire and Emergency Services Program." Dec. 21, 2006.
6. FAA, U.S. Department of Transportation. "14 CFR Parts 121 and 139 Certification of Airports; Final Rule." Federal Register, Feb. 10, 2004.
7. Coalition for Airport and Airplane Passenger Safety. "Surviving the Crash: The Need to Improve Lifesaving Measures at Our Nation's Airports." IAFF, 1999.
8. Phillips, Thomas J. "Airbus A380: Meeting the Challenge in 2006." Paper presented to the NFPA International Forum on Emergency and Risk Management, Singapore. January 2005.
9. NTSB. Safety Recommendation Letter A-98-41 through -42. June 25, 1998.
10. ICAO. *Airport Services Manual,* Part 1, "Rescue and Firefighting." Third Edition 1990. Nov. 14, 1995.
11. NFPA. "NFPA 403: Standard for Aircraft Rescue and Fire-Fighting Services at Airports, 2009 Edition." Sept. 5, 2008.
12. NFPA. NFPA 402.
13. Wright, Sr., Joseph A. "Aircraft Rescue and Fire Fighting Efficiency Relates to the Use of New Technology." Paper presented by Bernard Valois to the NFPA International Forum on Emergency and Risk Management, Singapore.
14. ACI. "ARFF Procedures Survey." February 2008.

‘Glideslope Unusable’

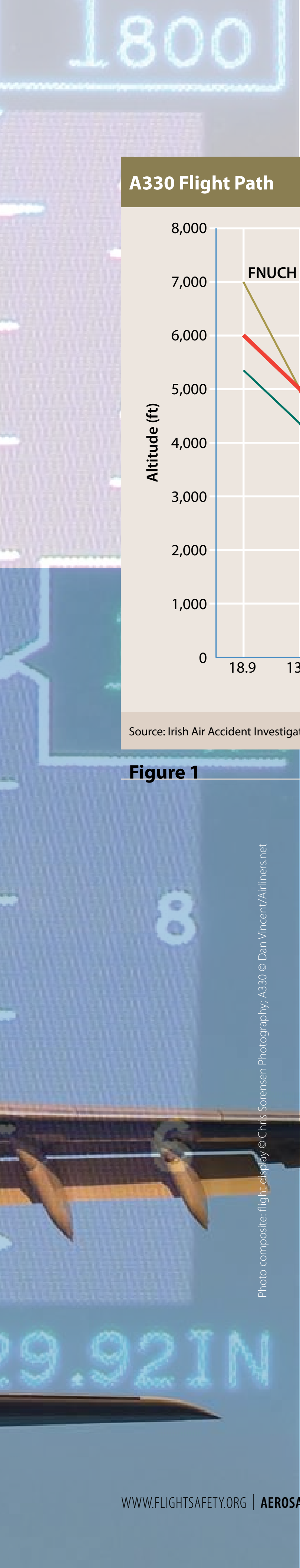
It took a moment, at a bad time, for the pilots to decipher an unexpected and unusual clearance.

BY MARK LACAGNINA

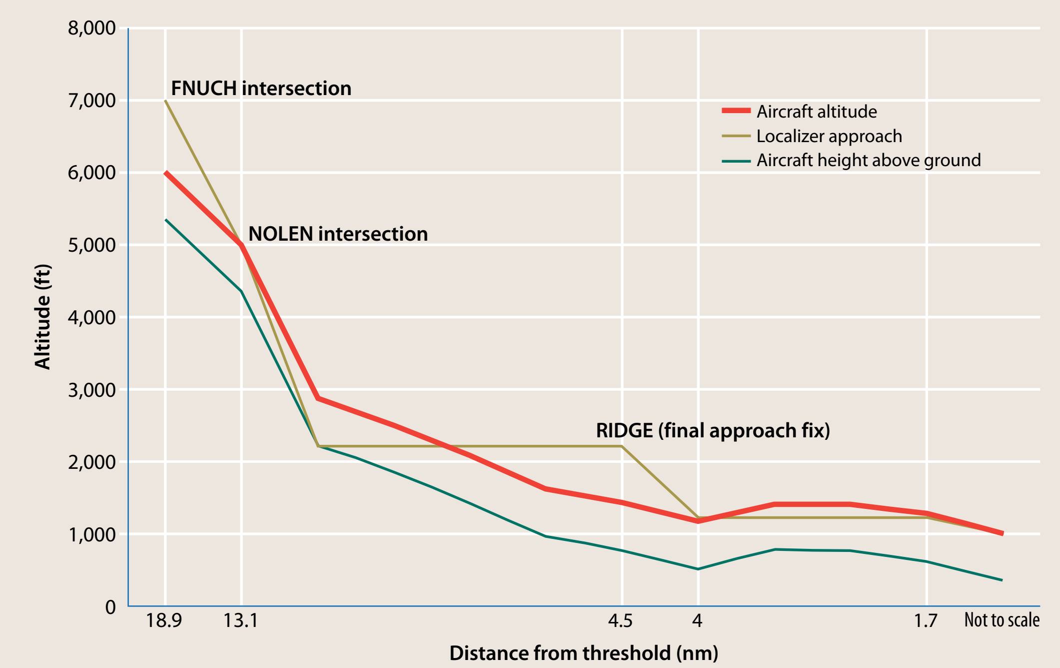
The Aer Lingus Airbus A330-300 had been airborne more than seven hours since departing from Dublin, Ireland, with 307 passengers and 12 crewmembers. The commander briefed the first officer for the instrument landing system (ILS) approaches to all three active runways at Chicago O’Hare International Airport. As the A330 neared the airport, air traffic control (ATC) issued vectors toward Runway 22R. The aircraft was about 20 nm (37 km) from the runway when the pilots were momentarily confused by a clearance to conduct the “ILS Runway 22R, *glideslope unusable*.”

The clearance was “unexpected and unusual,” and likely was “the initial destabilizing link in the chain of events” that resulted in the widebody aircraft being flown 774 ft below the correct flight path during the approach, said the final report on the Sept. 16, 2006, incident by the Irish Air Accident Investigation Unit (AAIU).

The commander, the pilot flying (PF), told investigators that he had not heard such a clearance before. Although the pilots decided that it meant they were to conduct a localizer-only approach, the commander said that lingering doubt about the clearance might have affected his performance, which included an error in



A330 Flight Path



Source: Irish Air Accident Investigation Unit

Figure 1

Photo composite: flight display © Chris Sorensen Photography; A330 © Dan Vincent/Airliners.net

mentally calculating the desired descent rate for the nonprecision approach.

The report said that the clearance phraseology *ILS … glideslope unusable* is a contradiction in terms: "The contradiction arises in that an ILS has two elements, a localizer and a glideslope. If either is inoperative, then it is not an ILS."

Air traffic controllers in the United States, however, are required to use that phraseology when the glideslope is out of service or a glideslope signal is being transmitted but either is not reliable for navigation or is not being monitored by ATC. The U.S. Federal Aviation Administration's *Air Traffic Control* manual says, "To require an aircraft to execute a particular instrument approach procedure, specify in the approach clearance the name of the approach as published on the approach chart."

In this case, although the pertinent approach charts published by the U.S. government and by Jeppesen include information for conducting a localizer-only approach, they are titled "ILS RWY 22R."

There is no International Civil Aviation Organization (ICAO) standard. The Irish and U.K. civil aviation authorities also have no published guidance, but ATC officials told investigators that their standard clearance phraseology includes the term *localizer-only*.

"In the JAA/EU [Joint Aviation Authorities/European Union] environment, the investigation has been unable to discover any published ATC clearance phraseology for use for an approach with the glideslope inoperative," the report said. "However, having consulted ATC units in a number of jurisdictions, the investigation has been advised that the same phraseology is used — that is, a clearance for a *localizer* or a *localizer-only* approach."

Scant Time to Prepare

Noting that the glideslope had become unserviceable 20 minutes before the A330 crew received the strange clearance, the report questioned why the pilots had not been advised of the outage sooner. "There should have been adequate time to alert the flight crew in advance of this major change to the approach procedure," the report said. "Late changes in approach procedure are particularly difficult for pilots operating modern-technology aircraft."

The A330 was being flown with the autothrottles and autopilot engaged. The amended clearance required the pilots to reprogram the equipment, and the lateness of the clearance left inadequate time to brief for the approach. "As a result, the flight crew had no pre-shared understanding or plan regarding the approach procedure," the report said.

In accordance with company standard operating procedures, the flight crew conducted a constant-angle, precision-like approach, rather than following the step-down procedure depicted on the approach chart (*ASW*, 10/07, p. 12). "The method trained by the operator is to use a steady rate of descent from the final approach fix … to arrive at the MDA [minimum descent altitude] at or slightly before the missed approach point," the report said.

The chart that the pilots were using, however, did not provide a distance/altitude table to facilitate the monitoring of a constant-angle localizer approach, and the crew did not have time to prepare their own table.

The commander mentally calculated the required descent rate for a three-degree glide path but did not account for the runway elevation: 651 ft. Thus, his calculation was incorrect. "The other routes flown by the operator are to airports whose altitudes are close to sea level," the report said. "Therefore, airport altitude is not normally a factor in calculating the height loss required during the approach. This possibly explains why the PF forgot to include runway height in his calculations."

Another possible factor is that the commander initially had been trained to use QFE altimeter procedures and had used the procedures during most of his career. "In a QFE approach, the altimeter indicates the height of the aircraft above the airport, and airport-elevation correction is not required," the report said.

Airbus A330-300

© Gabriel Widyna/Airliners.net

The twin-engine A330 and the four-engine A340 widebodies were developed simultaneously and share many structural and systems features. Their twin-aisle cabins accommodate as many as 440 passengers. The A330 entered service in January 1994, a few months after the A340.

The A330-300 is the base model; the A330-200 extended-range version, introduced in 1995, has a shorter fuselage and carries fewer passengers. The 300 is equipped with General Electric CF680E1, Pratt & Whitney 4164/4168 or Rolls-Royce Trent 768/772 engines. Maximum weights are 230,000 kg (507,058 lb) for takeoff and 180,000 kg (396,828 lb) for landing. Maximum range with reserves is 4,950 nm (9,167 km).

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

Cockpit Discord

Visual meteorological conditions with good visibility and light winds prevailed at the airport. Due to an altitude assignment by ATC, the aircraft crossed the FNUCH intersection 1,000 ft below the published approach height (Figure 1, p. 27). It then crossed the NOLEN intersection at the published altitude.

Up to this point, the approach was stabilized. Then, realizing that he had made an error in calculating the descent rate and perceiving that the aircraft was too high, the commander selected a steeper glide path angle. He did not tell the first officer about the change, and the first officer was not monitoring the approach when the change was made. The first officer told investigators that he was temporarily "out of the loop" while looking up the ground control frequency on the chart and selecting it as the standby radio frequency.

Recorded flight data monitoring (FDM) data showed that the aircraft descended below the correct flight path after crossing NOLEN and was 774 ft too low when it crossed RIDGE, the final approach fix.

The report said that during this time, the commander likely had been trying to acquire visual contact with the runway and did not perform a cross-check of altitude and distance to go. "As the approach was conducted in the late afternoon in the autumn [into diffused sunlight], it is probable that the runway approach lights and the airport itself would have been difficult to identify at a distance even though the visibility was probably in excess of 10 miles," the report said.

Indecisive Action

Soon after crossing the final approach fix, the commander realized that the aircraft was too low. The first officer said that he looked up when he heard the commander say that something was wrong. "He saw the runway and the preceding aircraft ahead and knew the picture did not look right," the report said.

The report said that the commander's subsequent actions were indecisive. FDM data showed that maximum continuous power initially was applied and the aircraft leveled off 509 ft above ground level and began a shallow climb; then, takeoff/go-around power was applied and the pitch attitude was increased to a value appropriate for a go-around. The commander told investigators that he believed he called for a go-around, but the first officer did not recall this. "[The commander] stated that if he had not called for a go-around, he had intended to do so," the report said.

As the A330 climbed above the MDA, the first officer suggested that the commander level off. "As they were coming into the normal visual landing slot and the aircraft was still configured for landing, the [commander] made a decision to land," the report said.

After landing, the commander and first officer briefly discussed the approach and decided that they did not have to file a mandatory incident report with the airline. Neither pilot believed that safety had been jeopardized or a height-control error of more than 300 ft had occurred — two conditions requiring a mandatory report. However, the commander filed a confidential report with the airline's safety office that focused on how the late and unusual change to the approach clearance led to the descent rate miscalculation and the poorly flown approach.

The seriousness of the flight path deviation later was discovered during routine analysis of FDM data by the airline. "When [the commander] saw the FDM data, he realized the occurrence should have been formally reported," the report said, noting that the AAIU was informed of the incident almost four months after it happened. "By that time, most records concerning the flight had been discarded, other than the operator's FDM data."

The aircraft's enhanced ground-proximity warning system (EGPWS) had not generated a warning during the approach. "Most [EGPWS] warnings are inactive once landing gear and flaps are extended on a nonprecision instrument approach, with the exception of a Mode 1 'excessive descent rate' warning and a 'terrain clearance floor warning,'" the report said. "The former is triggered by the aircraft descending at too high a rate of descent close to the ground — over twice the rate of descent recorded for the incident aircraft. The latter warning is triggered by a descent below a reducing floor height as the runway is neared; the floor height for the last 12 miles is 400 ft, reducing linearly to zero between 5 nm and the threshold."

Cases of Confusion

The report cited two accidents that occurred after flight crews received an approach clearance with the *ILS … glideslope unusable* phraseology. On Aug. 6, 1997, the first officer of a Korean Air Boeing 747 nearing the airport at Agana, Guam, did not acknowledge that the glideslope was unusable in his readback of the clearance (*Flight Safety Digest*, 5–7/00, p. 5). "Although there was a NOTAM (notice to airmen) published indicating that the glideslope was inoperative and cockpit voice recorder transcripts show that the crew had heard that the glideslope was unusable, its status was commented on a number of times during the approach," the report said. The 747 struck high terrain about 3 nm (6 km) from the airport.

The U.S. National Transportation Safety Board (NTSB) said that the probable cause of the Guam accident was "the captain's failure to adequately brief and execute the nonprecision approach and the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach."

On Feb. 18, 2007, the pilots of a Shuttle America Embraer 170 nearing Cleveland discussed the phraseology after hearing the clearance issued to the crew of a preceding aircraft. "It's not an ILS if there's no glideslope," the captain said. "Exactly," the first officer said. "It's a localizer." The 170 pilots, who received the same clearance, later told investigators that they were confused by the term *unusable*. [This was not considered a factor in the aircraft's subsequent overrun of the snow-covered runway (*ASW*, 9/08, p. 22). NTSB said that the probable cause was the "failure of the flight crew to execute a missed approach when visual cues for the runway were not distinct and identifiable."]

Based on its investigation of the A330 incident at Chicago, the AAIU recommended that standardized clearance phraseology for an approach using only the localizer element of an ILS be developed under the aegis of ICAO. Among other recommendations was that ICAO should require distance/altitude tables to be included on all nonprecision approach charts.

This article is based on AAIU Formal Report No. 2008-23, published Sept. 15, 2008.

BY LINDA WERFELMAN

Hydraulic Failings

Citing its investigations of six events since 2002, including two fatal accidents, the U.S. National Transportation Safety Board (NTSB) has identified hydraulic problems that led to "concern regarding the safe operation of Eurocopter AS 350-series helicopters."[1]

In examining the helicopters involved in the six accidents and incidents, NTSB investigators found excessive wear in the splined connection between the hydraulic pump and its pulley assembly. In some cases, the connection failed, and hydraulic power was lost.

A hydraulic power loss makes controlling a helicopter more difficult and increases the risk of a serious accident. Without hydraulic power, a helicopter can be operated in manual mode, "but doing so increases the physical demands on the pilot and can cause a serious accident if the pilot has not maintained familiarity with operation of the helicopter in manual mode or if an uncommanded reversion to manual mode occurs suddenly, especially during a critical maneuver," the NTSB said.

Letters from the NTSB to the European Aviation Safety Agency (EASA) and the U.S. Federal Aviation Administration (FAA) described how the hydraulic pump assembly functions:

"The hydraulic pump assembly is driven by a pulley assembly that contains a coupling sleeve. The coupling sleeve, with internal splines at its forward end, extends forward through the center of the pulley assembly to engage with the external splines on hydraulic pump drive shaft. A lubricant (specified in the maintenance manual as NATO grease G-355) is contained within the coupling sleeve by a plug inserted in the aft end of the sleeve and at the forward end, by contact with an O-ring located in a groove forward of the


© Eurocopter

The NTSB's discovery of excessive wear in AS 350 hydraulic connectors has prompted a call for replacement of faulty components.

drive shaft splines. The pump and the coupling sleeve are replaced 'on condition' (that is, when a problem is found during routine maintenance or during operation)."

The NTSB letters also described the six accidents and incidents in which the hydraulic pump assembly did not function as it should have.

The most recent incident, which occurred March 9, 2007, involved a loss of hydraulically powered control and a run-on landing.[2] An investigation found that a bearing had failed in the pulley assembly that drives the hydraulic pump, that the pump's drive shaft splines were worn to a thickness about 25 percent less than the splines' original thickness and that the pulley assembly's coupling sleeve splines were completely worn away, probably because of the bearing failure, the NTSB said.

Hardness testing of all the splines found that the measured hardness was "significantly below the requirements specified in the engineering drawings," the report said. In addition, "lubrication levels were found to be minimal, although 'abundant' was specified in the maintenance work card." Records indicated that the last 100-hour visual inspection had been conducted about 75 operating hours before the incident and the last 1,000-hour wear check had been done 622 operating hours before the incident.

The most recent fatal accident occurred March 8, 2007, at Princeville (Hawaii, U.S.) Airport after the pilot of the Heli-USA Airways air tour helicopter radioed a company dispatcher that he was experiencing "hydraulic problems" and expected to conduct a run-on landing, a preliminary NTSB accident report said. As the conversation continued, the pilot began describing the situation as a "hydraulic failure."[3]

The report said that the dispatcher continued monitoring the frequency and heard the pilot say, as the helicopter approached the ground, "Okay, we're done." Then, the report said, "the sound of the rotor changed pitch, and the helicopter impacted the ground."

The report quoted company employees and other witnesses as saying that the AS 350BA was unusually low during its approach to the airport, "moving slowly in a level attitude, seeming as though it would land in the grass." Then, one witness said, "all of a sudden, the nose went down and [the helicopter] hit the ground."

The pilot and three passengers were killed, and three other passengers received serious injuries in the crash, which caused substantial damage to the helicopter, the report said.

The accident investigation — including a laboratory examination of the hydraulic system — was continuing.

The other fatal accident occurred Sept. 20, 2003, when a Sundance Helicopters AS 350BA struck a canyon wall while maneuvering near Grand Canyon West Airport in Arizona, U.S.[4] The pilot and all six passengers were killed in the crash, which destroyed the helicopter (*ASW*, 1/08, p. 32).

The hydraulic system was not cited as a factor in the crash. The NTSB said in its final report on the accident that the probable cause was the pilot's "disregard of safe flying procedures and misjudgment of the helicopter's proximity to terrain."

An NTSB examination of the helicopter's hydraulic system revealed that about 10 percent of the splines on the hydraulic pump assembly's drive shaft had been worn away, "and their hardness was significantly below engineering drawing requirements." Tests measured hardness at the roots of the splines because case hardening in these areas usually is "pristine," the NTSB said.

The NTSB's examination of the hydraulic pump drive shaft–coupling sleeve assemblies from the six accident/incident helicopters compared those assemblies with a new assembly and two assemblies from other AS 350s and found that in the accident/incident helicopters, "neither the drive shaft splines nor the coupling sleeve splines met the hardness requirements in their respective [engineering] drawings and in some cases were deficient by significant amounts," the recommendation letters said. "In four cases, the coupling sleeve splines were completely worn away, and in the other two cases, coupling sleeve splines showed excessive wear."

Spline hardness in the assemblies that had been removed from the operating helicopters, as well as the new coupling sleeve provided by the manufacturer, also failed to meet the engineering drawing requirements, the letters said.

The NTSB's inspection also found that all but one of the coupling sleeves contained inadequate lubrication. In addition, in one coupling sleeve, a plug had not been installed; and in another, an O-ring had not been installed. All three conditions — inadequate lubrication and the absence of the plug or O-ring — exacerbate the problem of accelerated wear.

"The Safety Board is concerned because inadequate hardness and inadequate lubrication accelerate the wear in the splined connection, increasing the likelihood of in-flight failure," the letters said. "Potentially catastrophic wear on coupling sleeve splines could occur before the next wear check, which is required by the master servicing recommendations every 1,000 hours."

Eurocopter AS 350 and EC 130 manuals in use at the time of the accidents/incidents did not mention that coupling sleeve splines should be included when hydraulic pump drive shaft splines are visually inspected and lubricated, the letters said. A subsequent service letter added that requirement and reduced the visual inspection interval to 100 hours, down from 500; the requirement later was incorporated into maintenance manuals. The NTSB praised this action, noting that in all of the safety examinations cited in the six accidents/incidents, the coupling sleeve splines displayed more wear than the pump drive shaft splines.

"Although the Safety Board is encouraged by Eurocopter's action in regard to the inspection of the coupling sleeve splines, it remains concerned that the more extensive wear check will be conducted only at 1,000-hour intervals," the NTSB said. "The Safety Board is concerned that once the wear progresses through the casehardened layer on the coupling sleeve splines, the wear rate could accelerate, with the potential for hydraulic failure that could contribute to a serious or fatal accident."

The NTSB issued identical safety recommendations to the EASA and the FAA. The first called on the two agencies to require Eurocopter to "identify the AS 350 and EC 130 helicopter hydraulic pump drive shafts and coupling sleeves with splines that do not meet design specifications and take appropriate action to ensure that these parts (that is, replacement parts and parts to be installed in new helicopters) are expeditiously removed from the supply chain."

The second recommendation said that the EASA and the FAA should require operators of AS 350s and EC 130s to "perform a wear check, visual inspection and lubrication of the hydraulic power assembly splines and coupling sleeve splines in accordance with the latest version of the maintenance manual at the earliest opportunity, and thereafter require operators to repeat the wear check, visual inspection and lubrication of the splined connection at 100-hour intervals, and remove unairworthy parts from service."

Eurocopter AS 350

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

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

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

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

Notes

1. NTSB. Letters accompanying Safety Recommendations A-08-75 and A-08-76, directed to the FAA, and Safety Recommendations A-08-77 and A-08-78, directed to the EASA.
2. A run-on landing, often selected in situations involving a loss of power to the flight controls, is a landing in which the helicopter lands with forward velocity and slides to a stop.
3. NTSB. Accident report no. NYC07MA073.
4. NTSB. *Crash of Sundance Helicopters, Inc. Aerospatiale AS350BA, N270SH, Near Grand Canyon West Airport, Arizona, September 20, 2003*, NTSB/AAB-07/03. Oct. 30, 2007.

Can They Talk the Talk?

BY ELIZABETH MATHEWS AND ALAN GILL

Passengers listening in on radio communications on a domestic flight in the United States a couple of years ago heard the following exchange between the pilot and the Jacksonville (Florida, U.S.) Center controller:

> **Pilot:** "Jacksonville Control. United XXX. Can we reduce speed to xxx knots?"
>
> **Controller:** "United XXX. Jacksonville Control. Only if you want to join the back of the pack."
>
> **Pilot:** "Okay. We'll pin our ears back then."
>
> **Controller:** "You don't need to do that. Just maintain current speed."

This exchange is interesting from both a linguistic and an operational point of view, and illustrates how the International Civil Aviation Organization (ICAO) language proficiency standards and recommended practices (SARPs) apply to speakers of English as a first language.[1]

ICAO's language proficiency requirements call for all flight crewmembers, air traffic controllers and aeronautical station operators involved in international operations, regardless of their first

language, to demonstrate at least "operational" proficiency in English by March 2011. ICAO defines six levels of competence in English, ranging from "pre-elementary" Level 1 to "expert" Level 6; the "operational" level is Level 4.

Specifically, the brief radio exchange above highlights the following:

- The requirement for civil aviation authorities to distinguish between license holders who demonstrate ICAO Level 6 English proficiency and those who demonstrate lower levels of proficiency;
- The heightened importance of adherence to ICAO phraseology in the context of strengthened ICAO language proficiency requirements;
- The concurrent and inevitable need for plain language, even in routine situations; and,
- The particular responsibility of Level 6 speakers to be aware of the challenges of international radio communications and to deliberately and conscientiously use plain language.

Regulating Language

The ICAO language proficiency requirements regulate language used in radio communication — either the national language spoken by controllers on the ground, or English. For this article, we will focus on English proficiency testing. Although the contexts may be different, ICAO member states in which English is a national language are required to implement language proficiency assessments to ensure compliance in ways similar to states that do not have English as a national language.

Pilots and controllers who demonstrate Level 6 proficiency at their initial testing are exempt from further tests. Those who demonstrate operational Level 4 proficiency or "extended" Level 5 proficiency must undergo periodic retesting, and those with proficiency at Levels 1, 2 and 3 are expected to continue English-language studies.

A Challenge

A challenge for civil aviation authorities, particularly in states with English as a national language, is to determine which applicants require recurrent testing and which qualify as expert Level 6 speakers. ICAO does not automatically exempt "native speakers" from assessment, for reasons that make sense in the global context of ICAO standards.

Globally, more people speak English as a second or third language than as a first or "native" language. Multilingualism is the global norm, and monolingual English speakers, that is, people who speak only English, are a minority.

Determining native — or "first-language" — English ability in bilingual or multilingual speakers can be so problematic that, outside of monolingual situations, the term "native language" becomes meaningless. For example, many people who acquire English as a second, third or fourth language speak it as proficiently as if it were their only language. In addition, the widespread use of English in places such as India or Singapore adds further complexity to any attempt to determine native language proficiency.

ICAO standards do not, in fact, refer to native speakers. Instead, they discuss Level 6 proficiency, which can describe either monolingual English speakers or people who speak English as one of their languages. In either case, civil aviation authorities must have a procedure to distinguish between those who demonstrate Level 6 English proficiency and are exempt from further testing, and those at lower proficiency levels who require recurrent testing or English language training.

The New Zealand Example

For example, the Civil Aviation Authority (CAA) of New Zealand has implemented a comprehensive English-as-a-first-language assessment system with separate procedures to assess ICAO Level 6 English language proficiency.[2]

Since March 5, 2008, applicants for New Zealand airplane and helicopter pilot licenses, as well as air traffic controller and flight service

Just because pilots claim English as a native language, that doesn't mean their aviation English is up to par.

operator licenses — including existing license holders who apply for a different license — have been required to demonstrate at least Level 4 proficiency before a language proficiency endorsement is included on their license. The language assessments are conducted by Aviation Services Limited, the CAA's designated examination provider.

Two types of English language proficiency assessments are used.

One is the formal language evaluation (FLE), an assessment conducted over the telephone of pronunciation, structure, vocabulary, fluency and comprehension, followed by a brief telephone interview with a rater; during the interview, comprehension and interactions are evaluated. Each FLE is recorded and subsequently rated by two qualified language teachers who have received training on ICAO's language proficiency requirements and are familiar with aviation contexts and terminology.

The other assessment is the Level 6 Proficiency Demonstration (L6PD), a 10-minute telephone assessment designed to allow most New Zealand applicants who speak English as a first language to demonstrate Level 6 proficiency. It confirms that expert English speakers can meet all ICAO Level 6 language criteria — pronunciation, structure, vocabulary, fluency, comprehension and interactions — on a variety of familiar and unfamiliar topics but does not test technical knowledge or phraseology.

Because the L6PD is intended for pilots who are confident of their ability to communicate at Level 6, the only scoring outcomes are "Level 6" or "not determined." A "not determined" assessment may be a result of responses that were too short, contained long pauses or were not relevant to the topic. An applicant who receives a "not determined" assessment may not re-take the L6PD but must subsequently undergo an FLE to prove his or her proficiency. In some cases, an applicant with low Level 6 proficiency might fail an L6PD but subsequently be assessed at Level 6 in an FLE, in which more evidence is gathered.

The L6PD was developed by a team led by an associate professor of applied language studies and linguistics at a New Zealand university and includes various scenarios intended to elicit responses from applicants. These responses are assessed — by a rater selected from the same group that assesses FLEs — to develop a picture of the applicant's overall language proficiency.

Both the FLE and the L6PD cover the language required to communicate about common, concrete, aviation-related situations or tasks, including complications or unexpected events. The aviation context is appropriate for a range of applicants from private pilots to experienced air transport pilots.

Linguistic Analysis

Returning to the radio exchange over Florida, it is probable that both speakers were demonstrating Level 6 English proficiency. However, as the dialogue illustrates, expert speakers of English do not always exhibit the standards of care and communicative professionalism that the job demands.

ICAO Document 9835, *Manual on the Implementation of ICAO Language Proficiency Requirements*, prescribes a standardized linguistic method of analyzing radio communications. Using the aeronautical communicative language functions to analyze this brief exchange highlights two important points that enhance our understanding of the requirements of radio communications, especially in international communications.

First, even in relatively routine, non-emergency situations — "Can we reduce speed?" — there is very often a need to communicate information that is more subtle than ICAO phraseology alone may allow. In this case, the controller's response to the request to reduce speed is a conditional "yes but …" — that is, "Yes, you can reduce speed, but I will need to vector you around to rejoin the flight path behind the aircraft following you."

There is no published ICAO phraseology that permits the "negotiation" that this pilot and controller engage in. It is not realistic to expect phraseologies to cover every conceivable situation. The need for natural, or plain, language occurs not infrequently during normal flight operations. In fact, the SARPs have always made clear that ICAO phraseologies are intended to be representative and not exhaustive.

Second, the pilot and controller both resorted to idiomatic expressions — "join the back of the pack" and "pin our ears back" — probably as a kind of shorthand. Another phenomenon also may be present. In normal use, language allows humans to connect and establish relationships with one another. Playful use of language is friendly and helps build relationships.

In this case, it was clear that the pilot and the controller understood each other's idiomatic expressions. However, idioms, like humor, do not translate well across language barriers. ICAO Level 4 proficiency descriptors do not include the more advanced ability to understand idiomatic expressions. In international communications, with Level 6 pilots potentially sharing the airspace with pilots who speak English at Level 4, such language is not acceptable. Idiomatic expressions or any clever use of language hinders communication.

Natural Advantage

Pilots and controllers who speak English as a first language have a significant natural advantage because they do not normally require lengthy language training to earn or maintain a pilot certificate. In contrast, many of their international colleagues without English as a first or national language must make an extensive effort to learn English to Level 4 proficiency.

Similarly, airlines and air navigation service providers in nations with English as the dominant national language are not experiencing the same organizationally substantial language training requirements that face airlines and air navigation service providers in other nations. While there are currently no reasonable alternatives to English as the international language for radio communications, and while the ability to speak English with at least Level 4 proficiency is essential, it also should be recognized that an unequal distribution of training requirements inevitably results; this calls for a generous and thoughtful response from the industry and from individuals.

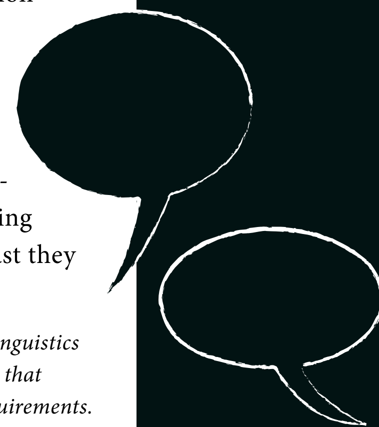
The first and easiest way for the industry to support global compliance with ICAO language SARPs is to strengthen individual, organizational and national adherence to ICAO phraseology.

In many parts of the world, pilots and controllers are required to complete a test on ICAO phraseology as a licensing requirement. All pilots flying international routes, regardless of their first language, should demonstrate proficiency with ICAO phraseology. Nations with published phraseology that differs from ICAO phraseology should carefully review communication procedures to align as closely as possible with ICAO phraseology.

Linguistic Awareness

Pilots and controllers also must become aware of the special challenges of cross-cultural radio communications and learn strategies that take those challenges into account. Basically, strict adherence to SARPs and guidance in ICAO documents is all that is required. Aviation professionals with Level 6 English proficiency are responsible for setting high standards for themselves in adhering strictly to ICAO phraseology whenever possible, and using plain language carefully and thoughtfully when ICAO phraseology is not adequate. ICAO guidance materials provide information intended to heighten awareness of the possible pitfalls of communicating across language barriers.

The English-speaking aviation world can undertake several measures to support global compliance with ICAO language standards, including collaborating to make aviation English materials widely available. However, three simple measures — adhering to ICAO phraseology, using plain language with brevity and clarity, and developing a respectful awareness of the challenges of communicating across language barriers — are the least they can do.



Elizabeth Mathews is a specialist in applied linguistics and was the leader of the international group that developed the ICAO language proficiency requirements. Alan Gill is general manager of Aviation Services Limited (ASL) New Zealand, which provides pilot and aircraft engineer examinations to the New Zealand Civil Aviation Authority (CAA) and the Australian Civil Aviation Safety Authority and flight testing services to the CAA.

Notes

1. ICAO. Document 9835, *Manual on the Implementation of ICAO Language Proficiency Requirements.*

2. Because New Zealand is an English-speaking country, the CAA has accepted that pilots who held a valid license before March 5, 2008, have demonstrated sufficient English language ability to adequately exercise the privileges of that license within New Zealand. Those who operate only domestic flights will not be required to take a language proficiency assessment; they also will not have a language proficiency endorsement on their license.

BY BRIAN DAY

CAREFUL Communication

The improvement of radio communication to foster a higher level of safety cannot be assured simply by the International Civil Aviation Organization's (ICAO's) implementation of a new set of language provisions, no matter how detailed and comprehensive they may be.

Better operational communication requires conscious effort by practicing controllers and flight crews to improve their personal performance across a range of techniques and procedures. In particular, it is vital that international flight crews and controllers conform more closely to ICAO standardized phraseology, which has been painstakingly developed over the last 50 years.

In the context of aviation operations, ineffective radio communication is a serious threat to safety.

This standardized phraseology is designed to communicate precise meaning in the conduct of aviation operations. Unlike common language that can mean many things to many people, the meanings of ICAO's standardized phraseology are singular. That is why this phraseology should always be scrupulously used without variation, addition or embellishment.

Language in its common usage lacks the specificity and exactitude that are essential to cooperative operational activity. Plain, or common, language is fundamentally symbolic; that is, its words and phrases represent the objects and concepts described. While this gives scope for the use of language in a multitude of situations with almost limitless contextual meanings, in an operational environment its inherent ambiguity compromises the need for the exact understanding that safety requires. The challenge of unambiguous communication becomes more problematic when radio communication involves non-native English-speaking controllers and pilots. Understanding how that is the case and why it makes conformity with standardized phraseology even more vital in international operations is important.

Words can be interpreted in different ways; this is the semantic barrier that complicates exchanges between men and women, engineers and musicians, soldiers and sports fans. No two people will take the same meaning from the use of any word, phrase or expression because everybody filters words through different belief systems, knowledge, cultural acquaintances and life experiences. Word meanings, therefore, are not absolute; meaning is subjective and a product of mind. It is worthwhile for pilots and controllers to remember that plain language is no more than representative of the things it describes and that words frequently mean different things to the speaker and the hearer.

With a closer understanding of the nature of language, its extraordinary powers and its distinct limitations, users of radio communications can be motivated to adhere more closely to ICAO standardized phraseology, knowing that it can mean only one thing in the context of its use. When standardized phraseology cannot be applied, pilots and controllers should take special care with enunciation, intonation and phrasing — and choose simple words that make messages unambiguous and concise.

The content of messages is not the only means of conveying sense in communication. For example, in face-to-face communication, body language speaks volumes, whether by facial expression, gestures, body posture or eye contact. Body language, in fact, has been found to convey 55 percent of message significance while words themselves convey only 7 percent. Tone of voice, too, is meaningful; it accounts for no less than 38 percent of message significance. Radio communication, however, is without body language prompts, and the electronically modulated voices of radio conversations rob speech of much of its expression.

In everyday life, the characteristics of language and the idiosyncrasies of communication cause many daily misunderstandings in casual conversations. The results are variously amusing, embarrassing and, sometimes, costly. In the context of aviation operations, however, ineffective radio communication is a serious threat to safety; in urgent or emergency situations in particular, when pilots or controllers may be fatigued or stressed, the results can be deadly. This, again, is most problematic for non-native operatives.

Those of us who are native English speakers with non-native English-speaking friends know how difficult it is for them to both enunciate English words and put them in proper English grammatical context, even in everyday conversation. English-speaking controllers and pilots should consider how much more difficult it is for their non-English-speaking counterparts to "get the picture." Under pressure or in an emergency, radio communication can quickly become compromised.

While the worldwide controller and pilot work force is committed to safety and efficiency of operations, there is sometimes a level of familiarity in the conduct of radio communication that belies this generally high level of responsibility. Being familiar in communication assumes a common culture; we use casual expressions and colloquialisms to enhance camaraderie among crews and controllers. But for unfamiliar crews and controllers, such culturally specific exchanges can be very isolating. They can reduce situational awareness and cause confusion among those who share the frequency but not the jargon. The potential consequences of misunderstandings are unacceptable.

The optimum strategy for safe communication is not to prescribe, coerce or threaten; it is to appeal to the innate responsibility of every controller and pilot to take the utmost care in communicating. When controllers and pilots better understand that language is an imperfect medium and is easily misinterpreted, they will be painstakingly accurate in their use of both standardized phraseology and plain language — and the airways will be safer because of it.

Brian Day was secretary of the international group that developed the ICAO language proficiency requirements and is now director of international business for Aviation English Services, based in Wellington, New Zealand.

The optimum strategy for safe communication is to appeal to the innate responsibility of every controller and pilot.

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

NATS tracks down why business jets figure prominently in altitude deviations in U.K. airspace.

Battling

© Stephen Rudolph/Dreamstime; Embraer

Deviating from your cleared flight level is never a good idea, especially in Europe's crowded skies, where a level bust could lead to a loss of separation with another aircraft. Business aviation, which accounts for about 7 percent of flights in the United Kingdom, was responsible for almost 20 percent of the level busts recorded in that airspace in the 2007–2008 period.

Between January and September 2008 in the airspace in which National Air Traffic Services (NATS) provides air traffic control (ATC) service in the U.K., there were 356 incidents involving business jets. Fourteen of these incidents were within the higher-risk category and involved a loss of separation, mainly due to level busts.

As part of its efforts to reduce the number and severity of level busts, the NATS Level Bust Workstream, a working group of representatives from across the company, has become increasingly concerned about the prominence of business aviation aircraft, in particular non-U.K.-registered, non-commercial operators, in the statistics. Of concern are not only the numbers but the severity of the busts; business jets caused five of the eight most serious losses of separation resulting from level busts in the six-month period that ended in June 2008 (Table 1).

The NATS Level Bust Workstream determined that the evidence of a problem is compelling. Going back to January 2007, the business aviation community accounted for 10 of the 19 most serious level busts recorded, 52 percent of serious bust events. Eight of those 10 events involved non-U.K.-registered aircraft. Given this disproportionate involvement in the higher-severity events, it is clear there is a need to focus effort on working in partnership with the business aviation community.

NATS believes that there are many reasons for the unwelcome prominence of corporate jets in the level bust event data. The nature of business flying is such that crews often find themselves flying into airports and associated airspace for the first time. For infrequent visitors, a lack of familiarity with some of the more challenging procedures in U.K. airspace is probably a major factor. Among these challenging procedures are step-climb standard instrument departures (SIDs), a feature at many of the London region's outer airports, where business aircraft are frequent visitors.

There have been many instances recorded, and not only among the business aviation community, of crews

Level Busts

BY PETER RILEY

"falling up the stairs" on a stepped profile. For business aviation, if the aircraft is flown by a single pilot, or if the crew is distracted from briefing the profile correctly — perhaps by having to perform functions that otherwise would be delegated to a flight attendant — the possibility of an incorrect or incomplete brief is increased. Throw into the mix that many business aviation crews may not have the level of flight operations support available to airline crews, and the very high performance of the aircraft that are being flown, especially in climb, and the reasons behind the prominence of corporate jets in the data become more obvious.

NATS has made great efforts to reduce the level bust threat, having introduced Mode S radars that display each aircraft's selected flight level (SFL) on the radar workstations within the Manchester Area Control Centre and in the London Terminal Control Operations Room at Swanwick Centre. Although this has had a very positive effect on reducing level busts, with controllers now able to see the flight level dialed into the mode control panel/flight control unit (MCP/FCU) by pilots following an instruction to climb or descend, it has not been the complete solution.

Serious Level Busts in NATS Airspace

Date and Aircraft	Summary	Primary Causal Factors
Jan. 14, 2008 Falcon 10/100	The airplane descended below its cleared level and came into conflict with a Boeing 737-800, which was under the control of a different sector. Slow TCAS response was to "maintain passenger comfort."	Incorrect TCAS response Rate of turn/climb/descent
March 7, 2008 Falcon 2000	The airplane was instructed to climb to FL 140 but climbed to FL 144 and into conflict with other traffic. The airplane had a very high rate of climb and may have misinterpreted a TCAS RA.	Incorrect TCAS response Rate of turn/climb/descent
March 10, 2008 Falcon 50	The airplane was instructed to climb to FL120. Approaching FL 110, it was given traffic information on an aircraft 1,000 ft above. The FA50 climbed to FL127.	Incomplete readback by correct airplane Not heard
March 11, 2008 Falcon 50	On departure the airplane was instructed to climb to FL 80. The airplane was later observed at FL 87. The pilot was climbing on the QNH local pressure altimeter setting.	Altimeter setting error Not seen
April 1, 2008 Cessna 560	An inbound airplane was descended to FL 120. An outbound Cessna was climbed to FL 110. Both airplanes approached BPK at the same time. The Cessna was observed climbing to FL 117 before descending again. The inbound airplane received a TCAS RA.	Incorrect TCAS response Poor manual handling
April 11, 2008 Learjet 45	A Learjet was instructed to climb to FL 80 against traffic descending to FL 90. The descending traffic reported a TCAS climb. The Learjet reported that it had also received a TCAS climb. It had climbed at 2,500 fpm with less than 1,000 ft to go.	Incorrect TCAS response Responded to TCAS/GPWS
May 26, 2008 Boeing 737-300	On climbout, the student pilot exceeded the cleared level by 600 ft before the training captain could intervene.	Correct pilot readback, incorrect action Pilot under training
June 3, 2008 Boeing 737-800	Traffic in a holding pattern was cleared to descend to FL 70. The pilot's readback was garbled by another airplane's transmission. The clearance was not clarified by the controller and an incorrect airplane descended to FL 70, causing a loss of separation.	Pilot readback by incorrect airplane Not heard

Reporting period Jan. 1, 2008–June 30, 2008

Source: NATS

Table 1

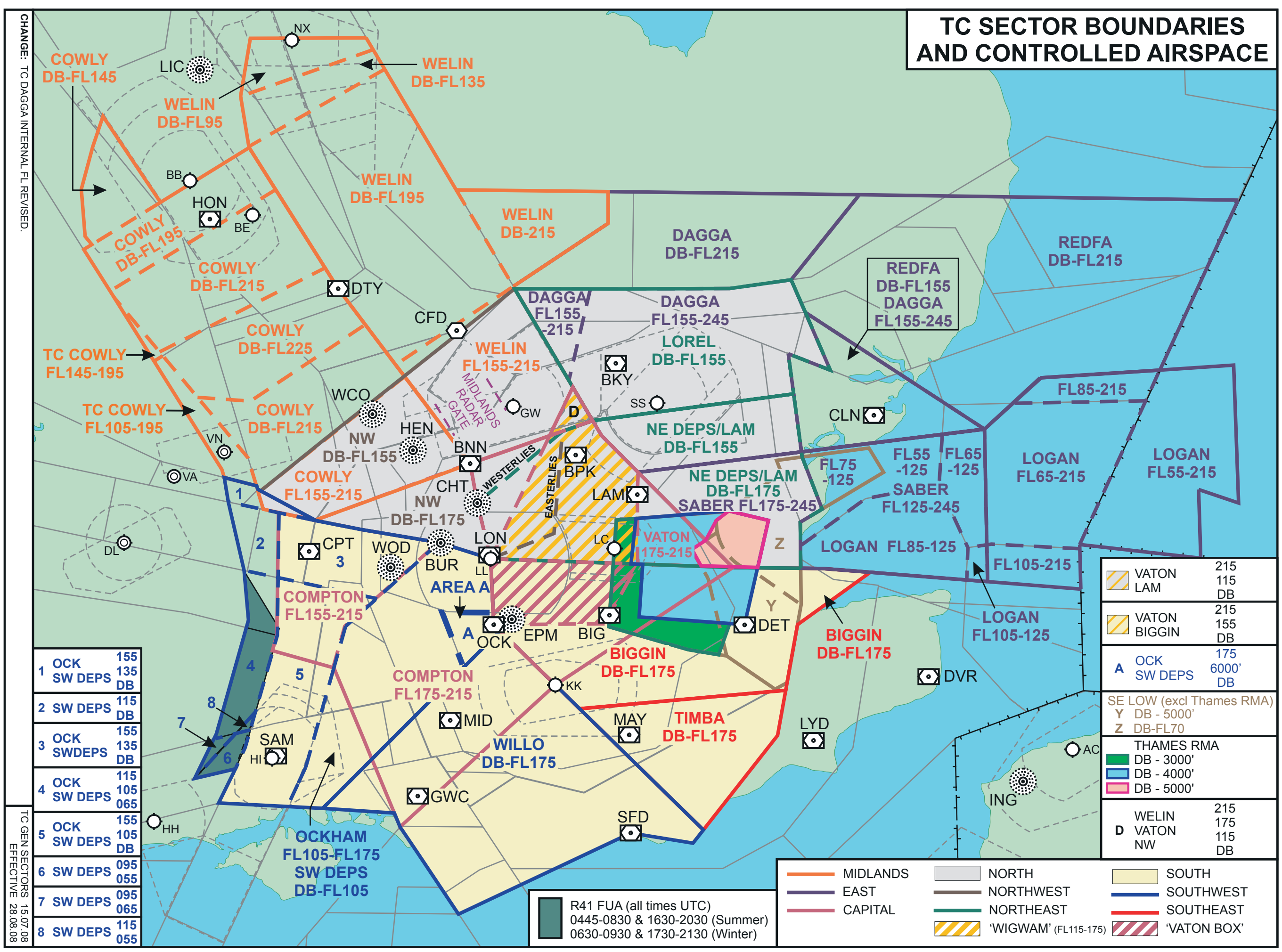
For example, the displayed SFL will not take into account any altimeter setting error made by the pilot. This is a common causal factor of level busts in the U.K. where the transition altitude — the boundary between setting altimeters for flight levels or for altitudes — is 6,000 ft in controlled airspace and 3,000 ft outside it.

It is appreciated that specific standard operating procedures (SOPs) are chosen to enhance operational effectiveness according to the nature of the operation. However, where a pilot has programmed a step-climb profile into the flight management system (FMS), unless there is an additional SOP to set the profile restrictions in the MCP, there can be a disparity between the aircraft's SFL and the programmed SID, which can increase controllers' workload as they try to ascertain whether a level bust is developing.

While there is little possibility that step-climb SIDs will be eliminated in the short term, avoidance of this procedure now is enshrined as a basic design principle for all future NATS airspace changes. In the interim, some successful mitigation measures have been applied at some NATS units; for example, providing with the departure clearance an explicit warning of the existence of a step-climb SID.

While Mode S SFL capabilities are helpful, data are beginning to indicate that new threats may develop: When the SFL displays the correct level to which an aircraft is cleared, controllers have a confidence in the crew's correct handling of the climb or descent that may turn out to be misplaced if the pilots do not adhere to sound airmanship principles of reducing the rate of climb or descent approaching the assigned level.

London's complex airspace can trip up infrequent visitors.



Avoiding Level Busts

NATS has identified a number of things that aircrew, especially business aviation crews, can do to minimize their chances of being involved in a level bust.

Crew preparation can be improved by:

- Ensuring that departure and arrival briefs are complete and include the transition altitude (which likely is lower in the U.K. than elsewhere), first-stop altitudes on stepped-climb SIDs, and the impact of low altimeter settings when transitioning between altitudes to flight levels; and,
- Understanding the profile, briefing the profile, flying the profile. Avoiding "falling up the stairs" on stepped climbs. Carrying out a specific review of the SID to be flown, with both pilots participating.

Communication can be improved by the following practices:

- Both pilots should wear headsets, monitor the frequencies and listen to the clearance;
- Use standard phraseology and avoid unnecessary radio chatter. When not sure, do not repeat clearances as a question; ask ATC to "say again";
- When changing the radio frequency, listen after the change before transmitting; be alert for similar call signs on your frequency; if you hear a readback error, let ATC know;
- Beware of confusing heading and level numbers; do not confuse 2s and 3s — for example, Flight Level (FL) 230/FL 330. Beware of a non-existent first digit — for example, FL 90, not FL 190; and,
- On first contact, always pass to ATC your current cleared level.

The following are examples of operational good habits:

- One pilot programs the FMS, another checks it; cross-check every MCP/FCU change, visually and verbally; cross-check altimeter settings;
- Apply crew resource management (CRM) skills (e.g., the pilot monitoring makes a standard call for altimeter setting on passing a set flight level); call out altitudes passing and feet to go when approaching the level-off;
- Avoid high rates of climb or descent approaching the level-off point to prevent unnecessary TCAS alerts; consider limits of 3,000 fpm with 3,000 ft to go; 2,000 fpm with 2,000 ft to go; 1,000 fpm with 1,000 ft to go;
- Understand how TCAS works and how to respond to TCAS RAs, including those not frequently practiced in the simulator;
- Set the clearance given, not the clearance expected; and,
- Maintain a sterile cockpit below FL 100.

— NATS

Further, a high rate of climb or descent can trigger a traffic alert and collision avoidance system (TCAS) warning on one or more aircraft under these circumstances, and the resolution advisory (RA) often is to continue the ongoing climb or descent. When this occurs, the SFL indication quickly becomes meaningless, and a situation the controller had every reason to believe was under control can quickly become a level bust. This is one of the reasons an "incorrect response to TCAS" might be attributed to a level bust, even though the actual response to the RA may have been correct.

In fact, an incorrect response to TCAS is recorded in half the level bust events.

Analyses of TCAS-related events by the NATS TCAS Working Group have found three major contributory factors. The most numerous by far were aircraft with high rates of climb or descent approaching the cleared level; about 75 percent of recorded TCAS events involve aircraft cleared to vertically separated levels generating "nuisance" TCAS RA maneuvers. Incorrect responses to TCAS RAs were less frequent, but often had far more serious consequences.

The causes behind an incorrect TCAS response varied. In some, crews reported choosing not to follow the RA to maintain passenger comfort or because they had visually acquired the other aircraft in the encounter. A more common cause was misinterpreting an RA, in particular misunderstanding an "adjust vertical speed" RA, an instruction to reduce the rate of climb or descent.

A normal TCAS response also can cause pilots to fail to maintain their ATC-cleared level when correctly following an RA; for example, an aircraft is climbed to a level with 1,000 ft standard separation below another aircraft and receives an "adjust vertical speed" RA. While staying within the green arc of the TCAS climb/descent guidance, the aircraft can level at 600 ft beneath the traffic, preventing a collision but eroding standard ATC separation.

The increased risk of non-response, late response or incorrect response to TCAS — as well as possible delayed reporting by pilots of a deviation in response to a TCAS RA — are some of the many issues that have been identified as being more common in single-pilot operations. The introduction of very light jets (VLJs), particularly when operated by one pilot, complicates this picture. Although low performance VLJs are likely to be treated from a controlling perspective much the same way as current turboprops, mid-performance VLJs will have higher cruising levels combined with slower speeds than other aircraft at those levels. This is likely to add to controller workload; and, given the evidence of incorrect response to TCAS already identified, NATS will need to monitor closely the level bust performance of single-pilot aircraft.

For NATS, having identified the level bust trend in the business aviation sector, the greatest challenge is to reach the correct audience with its mitigations. NATS has a very successful safety partnership agreement with many commercial operators in which it exchanges data and discusses issues in an open and frank forum. It also provides on a quarterly basis specific data on level bust performance to nearly 50 operators, including business jet fleet operators such as NetJets.

However, for the business aviation community beyond the U.K. air operator's certificate–holder sector, it has proven very difficult to reach the crews effectively. Small operators are too numerous, transitory, dispersed and infrequent U.K. airspace visitors to develop the longer-term relationship necessary to bring down level bust numbers. NATS has worked to develop ties with trade associations and simulator training providers, and has taken advantage of relationships with local handling agents to provide publicity and awareness initiatives. Ultimately, however, these strategies do not address the fundamental issue of directly engaging the target audience.

In an attempt to go further in addressing this issue, NATS has created a new workstream whose focus is on business aviation, as well as cooperating with the U.K. Business Aviation Safety Partnership. The work of these groups will consider improvements in pilot training, regulation and briefing.

Among training considerations are the following areas:

- Pilot training for global airspace and not just the country within which they are learning; and,
- Pilot training for a variety of conditions — emergencies, poor weather, etc.

Regulatory goals include:

- Promoting carriage of specific avionic equipment, such as Mode S transponders and, in some airspace, airborne collision avoidance systems; and,
- Adequate licensing, training and competency arrangements to expand knowledge of TCAS responses and airspace, airports and poor weather operations.

Briefing improvements may be achieved by:

- Facilitating access to adequate briefing material through handling agents, etc.; and,
- Encouraging correct briefing by the operators.

The focus of these groups is supported by the publication on Aug. 15, 2008, of the *Business Jet Safety Research Report, a Statistical Review and Questionnaire Study of Safety Issues Connected with Business Jets in the U.K.* This, in turn, has resulted in the formulation of a U.K. Civil Aviation Authority–led Safety Action Plan for Business Aviation. Although the work is not yet finalized in this area, it is clear that the need for specific attention to this sector of the aviation industry is greater than ever.

Peter Riley, a controller now working at NATS Corporate and Technical Centre in the United Kingdom, was NATS Level Bust Workstream Lead.

IMC in the Mountains

The pilot of a Bell 412SP emergency medical services (EMS) helicopter was navigating through dark night conditions and intermittent fog on a positioning flight when the helicopter struck a Southern California mountainside, killing the pilot and two medical crewmembers.

The U.S. National Transportation Safety Board (NTSB) said the probable cause of the Dec. 10, 2006, accident in Hesperia, California, U.S., was "the pilot's inadvertent encounter with instrument meteorological conditions [IMC] and subsequent failure to maintain terrain clearance." Contributing factors were "dark night conditions, fog and mountainous terrain," the NTSB said.

The pilot had 3,371 flight hours, including 3,094 flight hours accumulated during 12 years as a military helicopter pilot and 57 flight hours in airplanes. He held a U.S. Federal Aviation Administration (FAA) commercial pilot certificate for helicopters and an instrument rating. He was hired in December 2005 by Mercy Air Services to work at its Bell

© Alan Radecki/wikimedia.org

Investigators say an EMS helicopter crashed into a ravine after the pilot inadvertently flew into a fog-shrouded mountain pass.

BY LINDA WERFELMAN

U.S. National Transportation Safety Board

The wreckage was found on a mountainside in Southern California's Cajon Pass.

222U base in Twentynine Palms, California. After completing his initial training, he began flying EMS flights as pilot-in-command. He accumulated 220 flight hours while working for Mercy Air.

He moved to the operator's base in Victorville, California, in August 2006 and completed transition training for Bell 412SPs. His most recent U.S. Federal Aviation Regulations Part 135 check ride was conducted Aug. 29, 2006, and included 0.3 flight hours with an instrument training device.

"The check ride form noted that the pilot was not authorized [for] the use of an autopilot under instrument flight rules (IFR) flights," the report said. "The pilot was not IFR current, and not authorized by his company to conduct medical flights under IFR conditions, or [authorized for] the use of night vision goggles [NVGs] under any flight conditions."

The accident report did not say when the helicopter was manufactured but that it had a total airframe time of 9,978 hours, recorded during its last inspection. The date of the inspection was not included in the report. The helicopter had two Pratt & Whitney Canada PT6T-3B engines; at the last inspection, the left engine had 17,799 hours total time and 4,528 hours since major overhaul, and the right engine had 5,521 hours total time.

The helicopter was certified for day/night visual flight rules (VFR) operation by a single pilot. Although it had standard instruments for IFR flight, was certified for single-pilot IFR operations and had been approved by the FAA for VFR or IFR flights, either during the day or at night, the helicopter was assigned to a VFR base and was used only for VFR flights. It was equipped with a satellite-based automatic flight following system that provided the ground base with reports every 30 seconds that included the helicopter's global positioning system (GPS) latitude and longitude. Mercy Air had not yet installed the software upgrade that would have added reports of altitude and airspeed.

Mercy Air had begun equipping its helicopters with NVGs, but an NVG system had not been installed in the accident helicopter.

A VFR-Only Base

At the time of the accident, Mercy Air, operating as LifeNet, was a subsidiary of Air Methods Corp. of Englewood, Colorado. Air Methods employed about 700 pilots, including 335 LifeNet pilots and 50 Mercy Air pilots, and operated about 200 helicopters at EMS bases across the United States. The Mercy Air base in Victorville was one of five bases in Air Methods' Region 1. Because Victorville was designated as a VFR-only base, all pilots operated under VFR rules. They held instrument ratings but typically were not current in IFR operations.

The company was authorized to use specific helicopters and their autopilot systems in IFR conditions, so long as the autopilot was operational and the pilot had satisfactorily completed a proficiency check, the report said.

In addition to requiring an annual Part 135 check ride and annual safety training, the company encouraged its pilots to undergo training every six months that usually emphasized recovery from unusual attitudes and inadvertent IMC encounters.

The Victorville base was staffed by a lead pilot, one safety pilot and two line pilots, who operated in a regular rotation. Each flight was conducted by a pilot and, typically, two medical crewmembers.

The company's operations manual said that pilots were expected to use an operational risk assessment matrix before each mission flight — but not before non-mission flights in which only the crew was aboard — to help identify, evaluate and manage risks. Base policies called for the results of the risk assessment to be recorded on a flight manifest form. The accident pilot completed risk assessments for the first two missions of the day; in both cases, the risk was recorded as "G" — or "green," which typically means "normal operations."

Autopilot Use Encouraged

The company encouraged — but did not require — pilots at its VFR bases, including Victorville, to use the autopilot during operations in marginal VFR weather conditions or during night VFR flights. The check airman told investigators that some pilots, but not all, "configured the helicopter's autopilot with appropriate features and headings for a quick engagement if necessary" and used it regularly.

The operations manual said that, in the event of an inadvertent encounter with IMC, "the pilot's primary responsibility was to maintain attitude control (level the helicopter), heading control (turn to avoid known obstacles), add climb power and attain climb airspeed. The pilot should then climb to the area's minimum safe altitude, make no turns greater than a standard rate turn, contact air traffic control (ATC) and squawk 7700 [emergency code setting on the transponder]."

Weather conditions in Victorville, 15 nm (28 km) northeast of the accident site, at the time of the crash, included visibility of 10 mi (16 km), broken clouds at 3,800 ft and overcast at 4,900 ft. At Ontario (California) International Airport, 19 nm (35 km) southwest of the site, visibility was 10 mi, with a broken cloud layer at 3,800 ft and an overcast at 5,500 ft.

The area forecast had included an airmen's meteorological information notice (AIRMET) for IFR conditions, with mountains obscured by clouds, precipitation, mist and fog.

After being notified that an accident had likely occurred in the Cajon Pass, a safety officer in Victorville checked weather conditions in the area and determined that they included ceilings of about 4,000 ft.

Flight Request Denied

Pilots at the Victorville base work 12-hour shifts, either from 0800 to 2000 local time or from 2000 to 0800; their schedules call for a rotation of seven days on duty, followed by seven days off. The accident pilot began a seven-day work

Bell 412

© Ivan Cholakov/iStockphoto.com

The Bell 412, a variation of the Bell 212, was first delivered in 1981. It was Bell's first production helicopter with a four-blade main rotor. The 412 SP (Special Performance version) has an increased maximum takeoff weight and fuel capacity, and more seating options than the original Model 412.

The 412SP has two Pratt & Whitney Canada PT6T-3B-1 turboshaft engines that together are rated to produce 1,400 shp (1,044 kw) of power for takeoff and 1,130 shp (843 kw) of power for continuous operation.

The 412SP has a maximum takeoff and landing weight of 11,900 lb (5,398 kg), maximum cruising speed at sea level of 124 kt and maximum range at sea level with standard fuel and no reserves of 354 nm (656 km).

Source: *Jane's All the World's Aircraft* rotation Dec. 8, 2006, working from 0800 to 2130; on Dec. 9, he worked from 0800 to 2030.

The following day, he began duty at 0800. He declined the first flight request of the day because of poor weather conditions in the Cajon Pass. Later in the day, he conducted three medical flights. After the third medical flight, the pilot began a repositioning flight at 1742 to the base at Southern California Logistics Airport in Victorville from Loma Linda University Medical Center. Because only the crew was in the helicopter, the flight was conducted not under Part 135 but under the less stringent requirements of Part 91.[1] Nighttime visual meteorological conditions prevailed along most of the route, and a company VFR flight plan was filed.

The helicopter "inexplicably" traveled northeast instead of continuing along the highway.

Each of the day's flights had traversed the Cajon Pass, a primary flight path between Victorville and the San Bernardino/Riverside area east of Los Angeles. Company personnel told investigators that if visibility in the pass was obscured, their flights would "hug the east or west sides of the canyon, away from the obscurations," the report said.

"Satellite tracking data from the operator indicated that the helicopter appeared to follow the Interstate 15 (I-15) highway in the lower portion of the Cajon Pass," the report said. "The highway makes a large S-shaped route as it gains in elevation toward the top of the pass, which is about 4,200 feet mean sea level (MSL). The route along the highway is away from a [well-lighted] residential/industrial area, having a well-defined light horizon, toward rising and dark terrain. Once at the top of the pass, as the highway turns toward the northeast, the upper desert communities are once again well [lighted]. Near the upper end of the pass, the helicopter flight track indicated that it proceeded toward the east, away from the highway."

The tracking data showed that the helicopter had followed I-15 northbound almost as far as the summit of the Cajon Pass. Then, at a point where the highway turned north, the helicopter "inexplicably" traveled northeast instead of continuing along the highway, the report said. The last position data, recorded at 1755, showed that the helicopter was 0.4 nm (0.7 km) east of I-15. Wreckage was found 0.7 nm (1.3 km) east of the highway in a ravine on the mountainside at 4,026 ft MSL; it was at the base of a 100-ft (31-m) electrical transmission tower — one of a series of electrical towers depicted on aeronautical navigation charts east of the Cajon Pass running from north-northeast to south-southwest.

The report quoted a witness as saying that he had been in the area about the time of the crash and saw "what appeared to be the glow of a small grass fire" and watched it grow within five seconds into "a large fireball."

"The glow of the fire was obscured by waves of fog that would drift over the area in patches," the report said. The witness said the fog was "not very thick but would 'swoop down' and dissipate" at about 3,500 ft. The witness, who said that he flew kites, also told investigators that earlier in the day, he had measured winds in the area blowing "to the northwest" at about 13 mph (21 kph), with gusts to 29 mph (47 kph).

When authorities began receiving telephone calls reporting a fire on the mountain, callers mentioned fog in the area that obscured the tops of mountain ridges at the top of the pass, and the electrical towers. Rescue personnel said that "intermittent waves of fog" complicated their search for the wreckage. At the same time, skies at the destination airport were clear, and weather conditions at the bottom of the Cajon Pass were suitable for VFR flight.

Examination of the engines, airframe and flight control components that had not been destroyed by fire revealed no indication of pre-impact anomalies that would have precluded normal operation of the helicopter.

This article is based on NTSB accident report LAX07FA056 and supporting docket information.

Note

1. An NTSB special investigation, conducted after this and several other EMS crashes, contained several recommendations to the FAA, among them a call to require all EMS flights, including positioning flights, to be conducted in accordance with Part 135 (*ASW*, 9/08, p. 12).

This Way Out

More cabin crewmembers means more efficient evacuations.

BY RICK DARBY

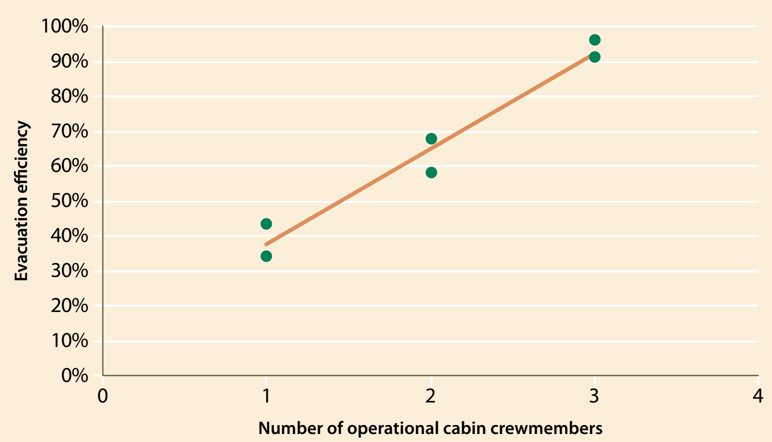
A "strong relationship" was found between the number of operational cabin crewmembers and evacuation efficiency in accident evacuations in a study supported by the U.K. Civil Aviation Authority (CAA; Figure 1).[1] But there was "no apparent correlation" between evacuation efficiency and the ratio of passengers to operational cabin crewmembers, those not disabled during the accident (Figure 2, p. 50).

Those were among the findings described in a CAA paper based on the Aircraft Accident Statistics and Knowledge Database (AASK), a collection of data in which narratives of evacuations in aviation accidents have factors coded for analysis.

The study reports on the analysis of an updated version of AASK, V4.0.[2] The latest AASK includes data provided mostly by the CAA and the U.S. National Transportation Safety Board. Accident information covers the period April 4, 1977, through Sept. 23, 1999, and consists of 105 accidents, 1,917 individual passenger records from survivors, 155 records based on cabin crew interview transcripts and 338 records of passenger and crewmember fatalities. Many of the evacuations studied were considered precautionary rather than emergency events.

Evacuation efficiency was defined as the theoretical shortest distance to the nearest viable exit divided by the actual distance traveled, both averaged for all passengers and for each aircraft. "The ratio … is a measure of the additional travel distance incurred by the

Number of Operational Cabin Crewmembers Compared With Evacuation Efficiency



Notes: Evacuation efficiency is defined as the theoretical shortest distance to the nearest viable exit divided by the actual distance traveled. The greater the efficiency, the less excess distance is traveled.

Operational cabin crewmembers are those who were not disabled in the accident.

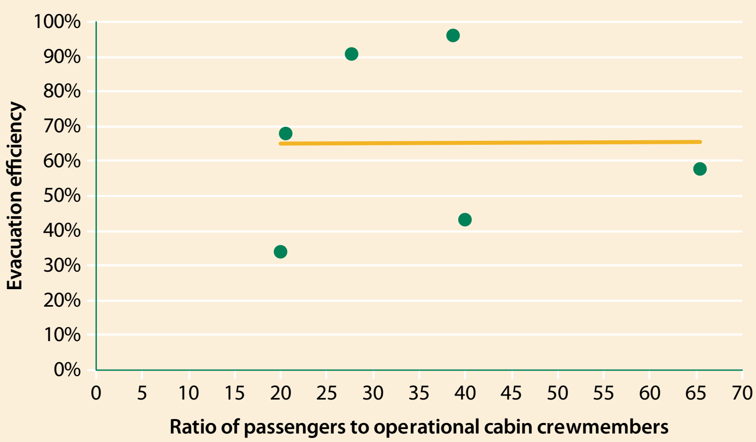
Each data point represents the average of passengers for whom data were available aboard one airplane in one evacuation.

Source: U.K. Civil Aviation Authority

Figure 1

passengers due to sub-optimal exit choice," the report says. "An evacuation efficiency of 100 percent indicates that all the passengers made use of their nearest viable exits, whereas values less than 100 percent indicate that not all of the passengers made use of their optimal exits."

Ratio of Passengers to Operational Cabin Crewmembers Compared With Evacuation Efficiency



Note: Evacuation efficiency is defined as the theoretical shortest distance to the nearest viable exit divided by the actual distance traveled. The greater the efficiency, the less excess distance is traveled.

Operational cabin crewmembers are those who were not disabled in the accident.

Each data point represents the average of passengers for whom data were available aboard one airplane in one evacuation.

Source: U.K. Civil Aviation Authority

Figure 2

The evacuation efficiency formula was designed to eliminate variables that could bias the results. For example, in precautionary deplaning situations where there was no immediate danger, cabin crewmembers often directed passengers to use a particular exit for safety and convenience rather than speed, so those evacuations were eliminated from the analysis. Among the other possible confounding factors excluded was the size of the aircraft, which would affect travel distance to an exit and the number of available exits. Six accidents, involving 247 passengers and single-aisle airplanes, satisfied the selection criteria.

Evacuation efficiencies in the six accidents ranged between 34 percent and 96 percent (Table 1).

"In cases where only a single crewmember is available, passengers have traveled as much as three times further than was theoretically necessary, whereas when three crewmembers are available, passengers traveled on average only 1.1 times further than was theoretically necessary," the report says. Pointing out that all cabin crewmembers might not be available to direct an evacuation, it says, "If the relationship between evacuation efficiency and cabin crew numbers suggested by [Figure 2] can be generalized, then the loss of even a single cabin crewmember may have serious implications

Evacuation Efficiency in Six Accidents

Accident	Maximum Passengers	Passengers on Board	Cabin Crewmembers on Board	Operational Cabin Crewmembers	Theoretical Passenger/ Cabin Crewmember Ratio	Actual Passenger/ Cabin Crewmember Ratio	Evacuation Efficiency
McDonnell Douglas DC-9-32	100	41	3	2	33	21	68%
Saab 340-B	34	20	1	1	34	20	34%
Boeing 737-300	128	83	4	3	32	28	91%
McDonnell Douglas DC-9-20	78	40	2	1	39	40	43%
Boeing 737-236	130	131	4	2	33	66	58%
Boeing 727-223	146	116	3	3	49	39	96%

Note: Data about exiting were available for 247 passengers. In the accident involving the Boeing 737-236, the one passenger more than the maximum was a child sharing a seat with a parent.

Source: U.K. Civil Aviation Authority

Table 1

for passenger safety. This will be particularly relevant in evacuation situations where any extra time spent in egress will compromise the survival chances of the passengers, such as situations involving fire."

The report analyzed variables among passengers who had difficulty releasing their seat belts in evacuations. A breakdown was made according to gender and three categories: those who helped other passengers; those who had difficulty and were helped; and those who had difficulty but managed without help.

"It is clear that males [in these accidents] have fewer problems with seat belts than females and that males are also more likely to render assistance to others than females [adjusted for the gender proportion]," the report says. It speculates that this could be because "males may be physically stronger than females and therefore are more able to deal with buckle difficulties" and "males may be less prepared to seek assistance than females and so they continue to struggle with the buckle and eventually succeed in releasing the belt."

Passengers were not generally asked about whether they had climbed over seats to reach an exit, so the data could offer no information about actual numbers or percentages of passengers who resorted to seat climbing. Of the 91 passengers who reported climbing over seats and whose age was known, the average age was 32.9 years, compared to the average 40.3 years of the surviving passengers.

"The mean age for female seat climbers has increased significantly from that in AASK V3.0 (which was previously 22.7 years), while the mean age for males has remained virtually unchanged," the report says. "In the female population reporting seat climbing, nine were aged 46 years and over. For the remaining 41 females (82 percent of all females both climbing seats and providing age), the average age is 25.4 years. These results suggest that there are more females climbing seats of various ages than previously estimated, but largely only younger females are prepared or able to tackle this task."

Direction of Travel and Distance Traveled in Evacuations

Direction	Number of Passengers	Traveled Minimum Distance?	Number of Passengers	Mean Distance (Seat Rows)
Forward	530/866	Yes	339/540	4.4/4.5
		No	191/326	11.3/12.4
Aft	300/511	Yes	200/334	5.1/4.9
		No	100/177	10.7/11.3
Exit row	49/64	Yes	49/64	0

Note: Figures before the "/" indicate starting and exit locations known from passenger self-reporting; those following are inferred.

Source: U.K. Civil Aviation Authority

Table 2

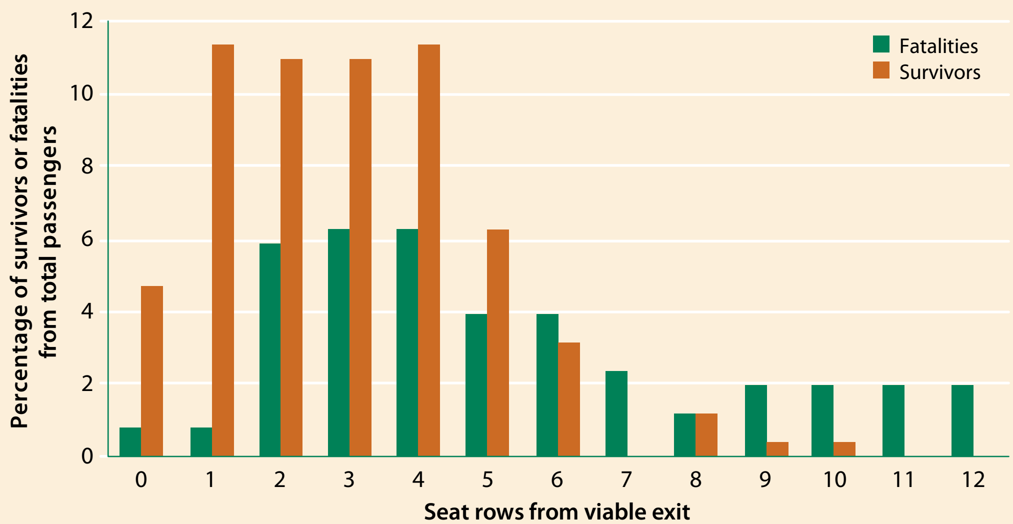
Among the 42 passengers who gave a reason why they had taken an over-seat route, the largest number — 12 males, five females — claimed that it was the shortest distance to an exit. The next most frequent reason cited — by four males and five females —was "aisle too congested."

"Within the aviation industry, it [is] a commonly held belief that most passengers evacuate via the most familiar exit, thereby ignoring closer but unfamiliar emergency exits," the report says. But the AASK analysis indicated otherwise. Based on passenger descriptions in which the seat location and exit used were identified or could be reliably inferred, such as from accounts by other passengers, it was found that 85 percent of passengers used the nearest available exit. The most common reasons for *not* doing so were "following cabin crew instructions," cited by 125 passengers, "following other passengers" by 65, "passenger thought this was the nearest exit when it was not" by 64 and "choice made before egress" by 27.

A slightly higher percentage of passengers who moved aft chose the nearest exit, but the majority of forward- and aft-moving passengers traveled the minimum necessary distance (Table 2). "This suggests that the overriding inclination of the passengers is to exit via their nearest exit, rather than to travel forward," the report says. "In addition, this further suggests that exit selection is based on a rational decision, at least for the survivors."

"Exit selection is based on a rational decision, at least for the survivors."

Distribution of Rows to Nearest Viable Exits for Survivors and Fatalities in Evacuations



Source: U.K. Civil Aviation Authority

Figure 3

Survival Rate for Front- and Rear-Seated Passengers in Four Evacuations

Aircraft	Survival Rate of Front-Seated Passengers	Survival Rate of Rear-Seated Passengers
McDonnell Douglas DC-9-32	33%	100%
Boeing 737-236	87%	30%
Boeing 737-300	53%	89%
McDonnell Douglas DC-9-20	75%	67%
Average	**65%**	**53%**

Note: Front and rear were measured from the middle row.

Source: U.K. Civil Aviation Authority

Table 3

Four accidents in the latest version of the AASK were found to have enough fatalities and known seat locations to compare survival rates with seat distances from a usable exit (Figure 3). All four accidents involved single-aisle airplanes. Analysis suggested that in those accidents there were three critical seating zones.

"In the first zone, identified from zero to one seat row from a viable exit, the number of survivors far outweighs the number of fatalities," the report says. This suggests that passengers seated this close to an exit are most likely to survive. In the second zone, identified as two to five seat rows from a viable exit, while passengers are more likely to survive than perish, the difference between surviving and perishing is greatly reduced. Finally, the third zone is identified as being six or more seat rows from a viable exit. Here, the chances of perishing far outweigh [chances] of surviving."

On average, the survival rate of passengers seated on the aisle was slightly higher than non-aisle-seated passengers, 64 percent versus 58 percent, the report says. In a division between the front and rear of the cabin, measured from the middle row, "on average there appears to be little difference between the two options," the report says. "However, variability between accidents is pronounced. On average, passengers seated in the front of the aircraft have a slightly higher survival rate than those seated in the rear" (Table 3).

Notes

1. U.K. CAA. *A Database to Record Human Experience of Evacuation in Aviation Accidents*. CAA Paper 2006/01. June 2008. The report is available at <www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=3176>.

2. Version V4.0 added data from 50 additional accidents, accounts from 622 additional passengers and 45 additional crewmembers, and data related to 11 fatalities. The earlier version, AASK V3.0, is available on request via the Internet at <fseg2.gre.ac.uk/AASK>.

A 'Charter' Member of the Safety Club

Beginning with handwritten notes, Elrey Jeppesen created charts for safer navigation and approaches.

BOOKS

Jeppesen: A Biography by His Son

Jeppesen, Richard. Xlibris, 2008. 582 pp. Photographs, appendixes. Order from the author.*

Every professional pilot is familiar with Jeppesen approach charts, so essential in modern aviation that it might seem amazing that anyone ever flew without them. Yet in aviation's early days they did, and many suffered the ultimate cost in collision with terrain or obstacles. Elrey B. Jeppesen, who was barnstorming long before the government got around to licensing pilots, might have been among the victims. Instead, he devised the Jeppesen Airway Manual of detailed maps showing terrain and safe approach profiles, among the most important safety developments in navigation.

Written by his son, himself a former airline pilot, this book offers a personal insight into Jeppesen's life and personality. Jeppesen, born in 1907 to Danish immigrants, not only created the Airway Manual, but was among the first to design en route, descent, approach and missed-approach procedures. Those tasks occupied him almost from the time he was hired to fly the mail for Boeing Air Transport in 1932.

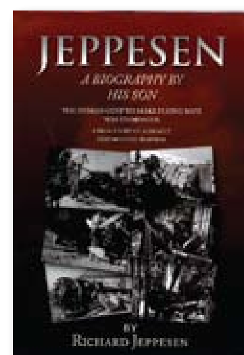
Elrey Jeppesen's story offers a grim reminder of the primitive conditions faced by the first generations of pilots. As the author says, "In the beginning, there were no universities of flight, no schools that taught flying, no books, no manuals, no flight rules, no minimum standards, no maintenance standards, no aircraft standards, no navigation facilities, and in the beginning no airports either." Other than all that, flying was a piece of cake.

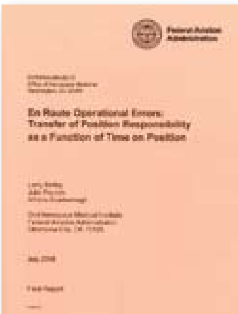
Carrying mail was the main source of airline revenue in the United States in the days before passenger transportation became a mainstay of the business. But with the contract for carrying the mail came pressure for on-time delivery, regardless of flying conditions.

"When the mail sack came in, no matter what the weather, it was expected that the pilot would load up and take off," the author says. "If he refused, the station manager would fire him on the spot and get another one to do it. The mountainous route between Cheyenne [Wyoming] and San Francisco was covered with airplane wrecks. Dad told me, after awhile, you knew where the wrecks were, because you had been up on the mountain putting the body of a fellow pilot in a black body bag. You could navigate from one wreck site to another, you knew the tragedy of them all." One winter, the fatality rate among the mail pilots was almost 30 percent, the author says.

Even in merciful weather, night operations brought their own perils and some imaginative responses by pilots: "Dad said he would land during a day flight and taxi up to a farmer's house on one side of a canyon. He would ask the farmer if he would be willing to light a small stack of hay if Jepp [Elrey] called him up some night so he could navigate through the canyon." Some pilots, including Jeppesen, navigated by using road maps and following railroad tracks.

He began to systematize the procedures that helped him avoid crashes like those that took the lives of so many of his fellow airmen. At first, he kept handwritten notes about the relatively safe approaches he developed, illustrated with his own drawings.





"In those days, there were contour maps available, so Dad would draw the approach lines over the contour maps, which also helped verify terrain clearance," the author says. "He would list radio frequencies, phone numbers and other information about the route and the airport. He would list the alternate, emergency landing fields along the way."

The original notebooks lacked any standard symbology, but when Jeppesen eventually got into the business of making charts, he knew that consistency would be essential. "As the chart business grew, Dad hired draftsmen to draw the charts," the author says. "He had to create a 'database' (we call it today), so any draftsman could lay out a new chart and his use of symbols would be exactly the same as the guy that was drawing another chart across the drafting room."

As word got around about the Jeppesen charts, pilots sent him information about airfields he had never been to. But before he published a chart, he insisted on being sure that the data were accurate: "It turned out, meetings had to be scheduled for the purpose of standardization and verification. Dad would assemble pilot groups and discuss, for example, the minimum en route altitude between Elko [Nevada] and Reno. Some guys felt one altitude was okay, and others felt if you were just a little off course, you would marry a pine tree on some nearby ridge. He told me it was not unusual for tempers to flare, egos would flex and a lot of the old guys did not like this new instrument flying anyway. They figured if you couldn't see, don't fly. Maybe that is why they were older."

After a disastrous period when the mail was carried by the Army Air Corps, which "was not remotely qualified," the author says, and during which the safety record became even worse than before, the airlines once again took on the job.

"The Airway Manual was up and running," the younger Jeppesen says. "He had secured a [US]$450 bank loan and printed 50 manuals. He sold out immediately. Along with this came the recognition that someone was finally doing something about all these problems. … Dad became the center of it all, and it was overwhelming."

The Jeppesen business clearly met a need, but he faced many more problems. Distribution was a major headache, but possibly the greatest challenge was keeping charts up to date. In the years preceding World War II, new construction at and near airports made updates imperative. Furthermore, there was no such thing as a standard approach in commercial aviation's early days — each airline had its own.

"So which approach did Jepp choose to publish?" the author asks. "It became a difficult matter of judging the merits of each approach and compiling the best and safest ideas. Jepp did just that. What an unbelievable task that must have been."

No doubt it was. But Elrey Jeppesen persisted and was ultimately so successful that his name became part of the language of aviation. Long before he died in 1996, he could take immense satisfaction in knowing that his work had saved countless pilots from a fate that he had seen, close up, far too many times.

REPORTS

En Route Operational Errors: Transfer of Position Responsibility as a Function of Time on Position

Bailey, Larry; Pounds, Julia; Scarborough, Alfretia. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-08/16. Final report. July 2008. 52 pp. Figures, tables, references, appendixes. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2000s/media/0416.pdf> or from the National Technical Information Service.**

A researcher review of studies on human factors associated with air traffic control (ATC) operational errors (OEs) suggests that a disproportionate number of OEs occur during controllers' first 10 minutes on position. "Unfortunately, we do not know whether further improvements need to be made to the position relief process or whether factors unrelated to the transfer of position are responsible," the report says.

To help clarify the issue, the researchers conducted a retrospective study of the FAA OE database. The study, part of a larger time-vulnerability research effort, examined OEs based on time of day, time since start of shift and time on position.

If the trend was related to position relief, it was not evident whether the position relief briefing (PRB) was inadequate or the controller entered the position during a busy traffic period. Each air traffic facility is required to develop a position relief checklist that covers steps such as a pre-transfer review of the situation by the incoming controller, a recorded verbal briefing by the outgoing controller and a post-transfer review by the outgoing controller.

"We have learned that there are two kinds of position transfers: those associated with replacement and those associated with providing assistance," the report says. The researchers found in their data review that position transfers for replacement did not generally occur during high-workload periods, so there was usually no need to rush. But transfers for assistance, such as when traffic was about to exceed the capacity of the controller on position and sectors had to be split between controllers, often did occur under time pressure and the process might have been hurried.

"The results [of examining the OE database] suggest that the position relief briefing process should address the unique human factors circumstances/vulnerabilities surrounding both types of position transfers, especially when the transfer process is rushed," the report says. "If, for whatever reason, there is only a short window of opportunity for the position transfer to occur, then the controllers involved have to depart from the ideal and address the reality that they face. Do the human factors vulnerabilities differ between a rushed replacement transfer, as compared to a rushed assistance transfer? For example, do controllers operate from a different mindset when they are being replaced versus when they are offloading only a portion of their position [control]?

"Questions such as these suggest that, although we have prescribed procedures that govern the position relief process, we know little about the varying states of mind and corresponding mental processes that are activated during a position transfer."

The researchers were inclined to conclude that past efforts to reduce OEs were of limited effectiveness because they looked for systemic problems that could offer generalized solutions. "This is a statistical approach in which individual differences are ignored and system-wide interventions are implemented," the report says. "However, for the individual involved in a given OE, the cause is not a statistical trend. Instead, the cause of the OE is associated with the specific mental processes (e.g., perception and vigilance, memory, and planning and decision making) and contextual conditions (e.g., static and dynamic sector characteristics) that affect the controller's performance.

"Thus, if we are to address the training needs of a given individual, we will have to switch from implementing a generalized training plan to a training plan that is customized to address specific needs based on the specific circumstances encountered. For example, an incoming controller who does not spend sufficient time mentally preparing to assume position control may not be aware of it."

The researchers concluded that present understanding of the cognitive processes involved cannot explain why OEs tend to occur early when a controller goes on position. "The current OE investigation process is insufficient for determining what the controller was thinking at the time of a position transfer," the report says. "This lack of information undermines the effectiveness of interventions designed to reduce OEs that occur early on position."

WEB SITES

Association of European Airlines, <www.aea.be>

The Association of European Airlines (AEA) has represented the major airlines of Europe for more than 50 years. AEA's Web site says its "primary objectives in the area of safety and operations include monitoring and influencing European and international rule-making on technical and operational

issues and the development of technical and operational requirements."

The Web site has, in addition to information on AEA policies, industry economics and related issues, two timely aviation safety documents about deicing/anti-icing of aircraft on the ground. Both may be viewed online, printed or downloaded at no cost.

- "Recommendations for De-Icing/Anti-Icing of Aircraft on the Ground," 23rd edition, Sept. 2008, 43 pages: Chapters include deicing/anti-icing methods for commercial transport airplanes using fluids, infrared technology and forced air technology; quality assurance programs; off-gate deicing/anti-icing procedures; and local frost prevention in cold-soaked wing areas. The document contains guidelines, tables, sample checklists and references to relevant SAE International and ISO (International Organization for Standardization) publications.

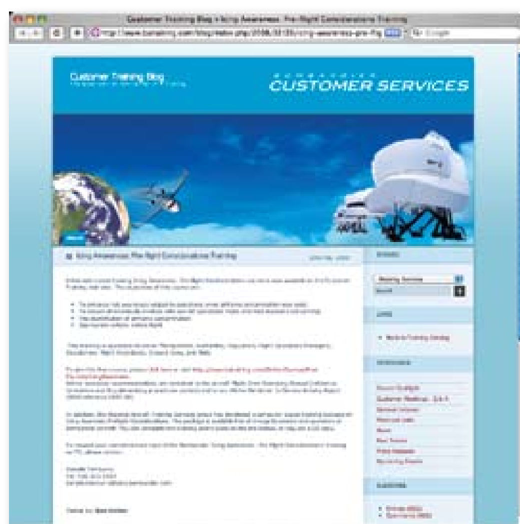
- "Training Recommendations and Background Information for De-Icing/Anti-Icing of Aircraft on the Ground," 5th edition, September 2008, 192 pages: The manual says it is "intended to provide a common basis for deicing/anti-icing training and qualification for deicing providers and airlines." The manual is divided into two sections: training and qualification recommendations and an overview of deicing/anti-icing procedures. It covers various topics including recommendations for qualifying staff, basic aerodynamics and meteorology relevant to deicing/anti-icing operations, and personnel safety and health issues.

Annex A lists aircraft types with detailed surface area measurements and dimensions and diagrams of spray/no-spray areas. Annex C contains an extensive bibliography of related readings. Annex D is a guide for developing lesson plans about theoretical and practical elements of deicing/anti-icing.

Icing Awareness: Pre-Flight Considerations Training, <www.batraining.com/blog/index.php/2008/02/20/icing-awareness-pre-flight-considerations-training/>

Bombardier Customer Services maintains a customer training Weblog that is open to the public. An icing awareness training program, applicable to commercial, business and other operations, is free online. The training program consists of audio-video presentations with graphics that address the following topics in general terms and are not limited to Bombardier airplanes:

- Low-speed aerodynamics;
- Effects of contamination;
- Contaminant formation;
- Contamination removal and protection; and,
- Deicing and anti-icing fluid application.



The reference materials section contains ground icing definitions, guidelines for deicing/anti-icing fluids, fluid holdover guidelines in table format, interactive holdover questions and answers, and more.

Instructions to obtain complimentary copies of the video on compact disc are provided. Information about other training materials specific to Bombardier airplane types is also available on the blog.

Sources

* <rfjeppesenbooks.com>

** National Technical Information Service, <www.ntis.gov>

— Rick Darby and Patricia Setze

Air Tanker Clips Trees

Pilots flew lower than the lead airplane on approach to fire-fighting drop site.

BY MARK LACAGNINA

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

JETS

Sink Developed in Turn to Final Approach

McDonnell Douglas DC-10-10. Substantial damage. No injuries.

The air tanker crew was fighting a wildfire in the mountains near Tehachapi, California, U.S., on June 25, 2007. "Although the flight crew was experienced with the operation of the accident airplane, they had limited fire-suppression experience," the U.S. National Transportation Safety Board (NTSB) report said. "[They] obtained the majority of their retardant drop experience — in excess of 100 hours using water for drops — during the certification testing for the airplane [which was modified with a fire-retardant-delivery system]."

The crew was performing their third retardant drop when the accident occurred. Per standard operating procedure, they circled over the drop site and observed the lead airplane fly the intended flight profile for the drop. The pilot of the lead airplane, the type of which was not specified in the report, also briefed the air tanker crew by radio during the maneuver. The procedure called for the air tanker crew to follow the lead airplane during the retardant drop.

"After joining with the lead airplane on the downwind leg for the retardant drop, they descended to about 7,700 ft," the report said, noting that the air tanker was about 1 mi (2 km) behind the lead airplane. "The run was set for a slight descent down the line of fire on a ridge."

The report said that the air tanker was lower than the lead airplane when it began the turn toward the drop site. The air tanker crew told investigators that as they performed a 30-degree-banked left turn from the base leg to final approach, the airplane began to sink, and they heard several "thump sounds."

"The captain verbalized the problem, advanced the throttles and rolled the airplane's wings level," the report said. "The flight engineer scanned the [left] wing and noted damage to the aileron, slat and flap."

The captain performed a climb to 11,000 ft and, with the lead airplane in trail, flew the air tanker to an unpopulated area, where the retardant was jettisoned. The crew then declared an emergency and landed the airplane without further incident in Victorville, California.

"The digital flight data recorder indicated that the airplane had entered a 35-degree left bank with a vertical acceleration from 0.8 to 1.4 g, which is consistent with normal loading in a banked turn," the report said. Firefighters found that the DC-10's left wing had struck 13 trees during the turn.

Fuel Leak Causes Nacelle Fire

Boeing 767-300. Substantial damage. No injuries.

The pilots and a line engineer found nothing unusual during their inspections of the 767 before it departed with 135 passengers and 12 crewmembers from Apia, Samoa, for a scheduled flight to Auckland, New Zealand, the morning of Dec. 30, 2006. Shortly after the thrust reversers were stowed on landing at Auckland, the flight crew saw a left-engine fire warning, said the report by the New Zealand Transport Accident Investigation Commission (TAIC).

The crew stopped the aircraft on the runway, reported the fire warning to the airport traffic controller and conducted the "Engine Fire" checklist. They shut down the left engine and activated the fire extinguisher. "All fire indications ceased 27 seconds after the first warning," the report said. The crew then taxied the 767 onto a taxiway and shut down the right engine.

At the crew's request, the controller had relayed through ramp personnel a request that aircraft rescue and fire fighting (ARFF) personnel confirm that the fire had been extinguished. The controller told investigators that, because the crew had not declared an emergency, he did not want to activate the crash alarm, which was his only direct means of communication with ARFF.

"Because of miscommunication, uncertainty about the severity of the situation and unfamiliarity with the aerodrome emergency plan, there was a nine-minute delay before the fire service arrived at the aircraft," the report said.

"There was a nine-minute delay before the fire service arrived at the aircraft."

ARFF personnel confirmed that the fire had been extinguished, and the 767 was towed to the terminal. "Engineers then confirmed that there had been a fire inside the left engine nacelle and that there was a leak from the fuel manifold," the report said. The leak had been caused by chafing of the fuel manifold by one of the 24 clamps that hold it in a loop around the engine. Cushioning material was missing from inside the clamp, and metal-to-metal wear had created a pinhole in the fuel manifold.

"Chafing was a known service issue that had been addressed by a service bulletin, but the bulletin instructions were found to be ineffective," the report said, noting that the damage had not been found during an inspection prescribed by the bulletin 450 flight hours before the fire occurred. After the accident, the engine manufacturer, General Electric, revised the service bulletin to require replacement of all the manifold loop clamps during each inspection.

Wind Shear Blamed for Hard Landing

Cessna 650 Citation III. Substantially damaged. No injuries.

The automatic terminal information service (ATIS) at Atlantic City (New Jersey, U.S.) International Airport was reporting 6 mi (10 km) visibility in light rain and mist, a broken ceiling at 800 ft and winds from 210 degrees at 15 kt, gusting to 24 kt, when the Citation flight crew conducted the global positioning system (GPS) approach to Runway 22 the morning of Oct. 27, 2007. The first officer, who had 2,535 flight hours, including 120 hours in type, was the pilot flying.

The airport traffic controller had issued wind shear advisories to pilots who had previously landed their aircraft on Runway 22 but did not issue an advisory to the Citation crew, the NTSB report said.

The landing reference speed, VREF, was 130 kt, and the captain made several callouts of "ref plus 10" as the airplane broke out of the clouds. The captain told investigators that the first officer appeared to be confused by airspeed indications on his airspeed indicator that were 5 to 10 kt higher than those on the captain's airspeed indicator. A postaccident examination of the pitot-static system found no anomalies, however.

The first officer saw an indication of 150 kt as the Citation descended below the minimum descent altitude in landing configuration. He reduced power to idle and momentarily deployed the speed brakes. "Review of the airplane flight manual (AFM) revealed that deploying the speed brakes below 500 ft AGL [above ground level], with the flaps in any position other than the retracted position, was prohibited," the report said.

The captain told investigators that he believed the airplane developed a high sink rate after encountering a wind shear at about 200 ft AGL. He told the first officer to increase power. "The first officer applied power to the spooled-down engines, but the airplane impacted the runway hard at about the same time the engines were again generating thrust," the captain said.

The impact drove the right main landing gear into the right wing, and the wing spar was substantially damaged. The Citation bounced, and the crew initiated a go-around. "During the go-around, the captain observed multiple cockpit warnings, including loss of hydraulic pressure, and he planned for a subsequent emergency landing without brakes or thrust reversers," the report said.

The crew landed the airplane on Runway 31, which, at 10,000 ft (3,048 m), is about 3,850 ft (1,173 m) longer than Runway 22. "During the rollout, the airplane traveled off the end of the runway at a speed of approximately 40 kt and came to rest upright about 100 ft [30 m] beyond the runway," the report said. None of the four occupants was injured.

Faulty Sensor Triggers Stall Indications

Boeing 747-400. No damage. No injuries.

The 747 was departing from London Heathrow Airport with 386 passengers and 20 crewmembers the afternoon of Dec. 7, 2006, when both stick shakers began to operate continuously at 140 kt — 5 kt below V_1, the speed at which the flight crew must take the first action to either continue or reject the takeoff following an engine failure at a lower airspeed. "The commander elected to continue the takeoff," the U.K. Air Accidents Investigation Branch (AAIB) report said.

The copilot continued flying the aircraft and also handled radio communications so that the commander could concentrate on analyzing the situation. "Throughout the initial climb, the commander verified that the aircraft's speed, attitude and thrust were correct, and he concluded that he had been correct in his initial analysis: the warning was not a genuine indication of the aircraft approaching an unacceptably high angle-of-attack. … He pulled both [stick shaker] circuit breakers, which caused the stick shakers to stop [operating]."

The copilot leveled the aircraft at Flight Level (FL) 170 (about 17,000 ft), and the pilots discussed whether they should continue the flight to New York or return to London. During this time, they noticed an "ALT DISAGREE" message on the engine indication and crew alerting system (EICAS) display. Indicated altitudes were FL 170 on the copilot's primary flight display (PFD), FL 167 on the commander's PFD and 167 on the standby altimeter. Shortly thereafter, an "IAS DISAGREE" message appeared on the EICAS.

The commander consulted the quick reference handbook but found "no immediate resolution of the condition," the report said. "The flight crew then determined, from their knowledge of the aircraft's systems, that the problem was rooted in one of the two air data computers (ADCs)." After switching from the no. 1 ADC to the no. 2 ADC, they found that both PFDs were displaying the same altitudes and airspeeds.

The crew consulted by radio with company operations personnel and decided to return to Heathrow. After dumping some fuel, they landed the 747 without further incident. Maintenance engineers reviewed built-in test equipment (BITE) data for the no. 1 ADC and decided to replace the computer.

After being returned to service, the 747 departed from Heathrow about three hours after the first takeoff. The stick shakers again began to operate 5 kt below V_1. This time, the crew rejected the takeoff and taxied the aircraft back to the terminal while carefully monitoring brake temperatures. "The passengers were accommodated overnight near the airport, and the flight and cabin crew carried out appropriate post-flight actions before going off duty," the report said.

Examination of the 747's pitot-static system the next day revealed that the stick shaker system activated even when the right angle-of-attack (AOA) vane was in a horizontal position. "Accordingly, the right AOA sensor was changed,

"Throughout the initial climb, the commander verified that the aircraft's speed, attitude and thrust were correct."

and the system was retested with satisfactory results," the report said. "The aircraft was returned to service, with no further problems being reported by flight crews."

Collision During Simultaneous Pushbacks

Boeing 757-200, Bombardier CRJ700. Substantial damage. No injuries.

Night visual meteorological conditions (VMC) prevailed at San Francisco International Airport on Jan. 13, 2008, when the airport ground traffic controller cleared a maintenance technician aboard the 757 for pushback from Gate 80 and, about 41 seconds later, cleared the CRJ flight crew for pushback from Gate 79. "Review of air traffic control (ATC) communication recordings revealed that the ground controller did not advise either aircraft of near-simultaneous pushback operations," the NTSB report said.

After being pushed back from the gate, the CRJ, with 55 passengers and five crewmembers aboard, was stopped on a taxiway with the engines operating and the parking brake set. The two wing walkers were disconnecting the tow bar when they saw the 757 approaching. They were running toward the 757 to warn the tug operator when the 757's tail struck the CRJ's tail.

The 757 had been pushed back without wing walkers or tail walkers. The tug operator told investigators that he did not see the CRJ. He stopped the tug after the maintenance technician on the flight deck felt "several bumps" and asked him if the tow bar had broken or the 757 had "hit something."

The collision substantially damaged the CRJ's vertical stabilizer, rudder and elevator, and the 757's rudder and elevator. There were no injuries.

TURBOPROPS

EMS Flight Strikes Mountain

Raytheon King Air C90A. Destroyed. Three fatalities.

Night instrument meteorological conditions prevailed when the King Air departed from Chinle, Arizona, U.S., with a flight nurse and paramedic for an emergency medical services (EMS) positioning flight to pick up a patient in Alamosa, Colorado, on Oct. 4, 2007. The pilot did not file a flight plan, and there was no record that he obtained a preflight weather briefing, the NTSB report said.

Shortly after takeoff, the pilot radioed the company's dispatch office that his planned cruising altitude was 12,500 ft and estimated time en route was 30 minutes. "The company dispatch did not have any flight-following capabilities," the report said.

The pilot then established radio communication with Denver Center and requested flight-following services. The controller assigned a transponder code and established radar contact with the King Air. Recorded radar data indicate that the airplane climbed to 13,500 ft, descended to 11,500 ft and then climbed back to 13,500 ft.

A few minutes before the crash, the pilot was instructed to change to a different center radio frequency. On initial contact, the pilot reported that he was "on the descent into Alamosa" and requested the minimum vectoring altitude. The controller asked him to repeat the question, and the pilot said, "What is the MSA [minimum safe altitude] out here? Do you know?"

The controller said, "I guess I'm just not understanding what you're saying. Either I'm really tired [or] you're talking too fast. Slow her down for me a little, will you?"

The pilot said, "I'm actually new into Alamosa. Just wondering what the minimum descent altitude was out here." The controller told the pilot that he would be "cutting across the corner" of an area with a minimum instrument altitude of 15,300 ft and that "it goes down after that." The pilot acknowledged the transmission.

About one minute later, the controller radioed that radar contact had been lost, but there was no reply. The wreckage of the King Air was found the next day at an elevation of 11,900 ft in mountainous terrain about 40 mi (64 km) from Alamosa.

"A review of the handling of the accident flight showed that the controller was aware of the airplane's position, altitude, general route of flight and its proximity to terrain," the report said. "No safety alert was issued to the accident flight."

The report said that the controller's failure to issue a safety alert to the pilot and the pilot's inadequate preflight and in-flight planning and decision making were contributing factors in the accident. The probable cause of the accident was "the pilot's failure to maintain clearance from mountainous terrain," the report said.

Short Touchdown in a Blizzard

British Aerospace Jetstream 31. Substantial damage. No injuries.

The aircraft was on a scheduled flight with 10 passengers from Grande Prairie, Alberta, Canada, to Fort St. John, British Columbia, the morning of Jan. 9, 2007. En route, the flight crew obtained ATIS information indicating that the destination airport had surface winds from 360 degrees at 10 kt, 1 to 3 mi (1,600 to 4,800 m) visibility and a vertical visibility of 2,300 ft.

However, the weather deteriorated rapidly into blizzard conditions as the Jetstream neared Fort St. John, said the report by the Transportation Safety Board of Canada. The crew was conducting the instrument landing system (ILS) approach to Runway 29 when a flight service specialist told them that the wind was from 310 degrees at 30 kt, gusting to 40 kt, runway visual range (RVR) was 2,800 ft (about 880 m) and the sky was obscured. Minimum RVR for the approach was 2,600 ft (about 810 m).

"The first approach was discontinued due to the aircraft being too high on the final approach leg," the report said. During the second approach, the captain, the pilot flying, maintained a flap setting of 20 degrees. The Jetstream was at 300 ft AGL when the first officer called the ground was in sight. He then called the approach lights in sight.

The captain confirmed that the approach lights were in sight and called for the full-flaps setting, 35 degrees. "When the flap setting was increased from 20 degrees to 35 degrees in the final stage of the approach, the aircraft would have become destabilized; there would have been a tendency for the aircraft to pitch up and lose airspeed," the report said. "Since the captain's focus was outside the aircraft and his attitude reference was reduced in the low visibility, it would have been difficult to judge aircraft pitch attitude and height above the ground."

Neither pilot was monitoring the instruments, and "a significant deviation below the optimum glideslope went unnoticed by the crew," the report said.

The aircraft touched down 320 ft (98 m) short of the runway threshold in about 16 in (41 cm) of packed snow, struck approach lights, bounced and touched down again 180 ft (55 m) short of the threshold. "After sliding through the threshold lights, the aircraft came to rest on the right edge of the runway," the report said. "The main gear had broken off, and the nosegear had collapsed rearward. Both propellers were damaged by ground contact. The aircraft was equipped with a belly-mounted cargo pod, which supported the fuselage during impact."

Neither pilot was monitoring the instruments.

'Dump' Switch Selected by Mistake

Beech King Air 300. No damage. No injuries.

En route on a charter flight with seven passengers from Melbourne, Victoria, Australia, on Feb. 6, 2007, the King Air was 140 nm (259 km) south of the destination — Alice Springs, Northern Territory — and the pilot was preparing to descend from FL 280 when he felt his ears "pop" and observed indications of rapid depressurization.

After donning his oxygen mask, the pilot ensured that the passengers had donned their oxygen masks, initiated an emergency descent and declared an emergency with ATC, the Australian Transport Safety Bureau report said. He landed the aircraft at Alice Springs without further incident.

The pilot told investigators that during the emergency descent, he noticed that the pressurization system switch, which is on the left side of the center control pedestal, was in the "DUMP" position. "The pilot reported that it is possible that, while adjusting his seat position prior to top of descent, he inadvertently activated the switch to the 'DUMP' position," the report said.

PISTON AIRPLANES

Engine Fails During Low, Slow Flight

Piper Aztec. Destroyed. Two fatalities.

Modified with a chemical-dispensing system, the Aztec was on a public-use flight the afternoon of Sept. 14, 2006, spraying insecticide to control mosquitoes near Fort Meade, Florida, U.S. A witness saw the airplane pass overhead at low altitude and heard one of the engines "throttle back, then rev up and sputter," the NTSB report said.

The witness said that the propeller on the right engine was turning slowly when the airplane pitched nose-up, rolled right and descended to the ground. The pilot and observer were killed.

A teardown inspection of the engines revealed no anomalies, and investigators were unable to determine the cause of the apparent failure of the right engine. The report said that the power loss likely occurred at an airspeed below minimum single-engine control speed (VMC) and "at an altitude too low to afford a safe recovery."

Misfire Occurs During Overwater Flight

Gippsland Aeronautics GA8 Airvan. Substantial damage. No injuries.

The single-engine utility aircraft was being used for a scheduled flight with one passenger from Wellington, which is on the southern coast of New Zealand's North Island, to Kaikoura, on the northeast coast of South Island, the morning of Nov. 27, 2006. VMC prevailed, and the pilot planned to conduct the 56-km (30-nm) overwater segment across Cook Strait at 3,000 ft, the TAIC report said.

The pilot told investigators that about eight minutes after takeoff, the engine "gave a kick" and he observed that oil pressure had dropped from the normal 60 psi and was fluctuating around 40 psi. "The pilot reduced power slightly and turned back toward Wellington airport," the report said. "He advised ATC of the situation and requested priority for landing, but he did not declare any urgency or request the airport rescue services to be placed on standby."

After the pilot landed the aircraft at Wellington without further incident, metal debris was found in the Lycoming IO-540K engine's oil sump. A subsequent teardown examination of the engine revealed that the valve tappets in five of the six cylinders had "disintegrated," the report said. The damage apparently began with the sticking and failure of the exhaust valve tappet in the no. 4 cylinder, but investigators were unable to determine why that tappet failed.

Noting that the aircraft had life vests aboard but did not have, and was not required to have, a life raft, the report said, "The ditching risk that was present with overwater air transport operations with single-engine aircraft and the means of mitigating that risk had not been fully considered by the operator or the [New Zealand Civil Aviation Authority]."

ILS Approach Procedure Not Followed

Cessna 414A. Destroyed. Three fatalities.

As the 414 neared the destination — Lawrenceville, Georgia, U.S. — the night of Dec. 25, 2006, ATC told the pilot that weather conditions at the airport included 1/2 mi (800 m) visibility in fog and a 100-ft ceiling. "The pilot acknowledged the information and elected to continue for the ILS approach," the NTSB report said.

When the pilot subsequently reported a missed approach, he told ATC that he saw the airport below and intended to conduct another ILS approach. "During the second approach, the tower controller advised the pilot that he was left of the runway centerline," the report said. "Shortly after the pilot acknowledged that he was left of the centerline, the tower controller saw a bright 'orange glow' off the left side of the approach end of the runway." The 414 had struck trees and crashed in a construction yard.

The report said that the probable cause of the accident was "the pilot's failure to follow the instrument approach procedure." A contributing factor was his "descent below the prescribed decision height."

HELICOPTERS

Lightning Strikes Main Rotor Blades

Eurocopter AS332-L2. Substantial damage. No injuries.

The Super Puma entered a line of rain showers about 15 minutes after taking off from a platform in the North Sea to transport 15 passengers to Aberdeen, Scotland, the afternoon of Feb. 22, 2008. "About 30 seconds after entering the line of showers, both pilots saw a bright flash at the rotor tip in the one o'clock position, accompanied by a 'bang' or 'pop' sound," the AAIB report said.

The lightning strike did not cause any noticeable effects, but the pilots decided to divert the flight to the nearest available platform. "It was then established that the nearest suitable platform had unfavorable weather conditions and all other suitable platforms reported winds in excess of 50 kt," the report said. "The crew therefore elected to continue on to Aberdeen, where an uneventful landing was made."

Examination of the helicopter revealed that all four main rotor blades had been damaged and that one blade had been damaged beyond repair. "The damage included arcing damage to the leading edge anti-erosion strips, broken bonding leads and damaged trim tabs," the report said. "High-energy tracking was also visible on two main rotor pitch link ball joints and one main rotor servo upper ball joint."

No air-to-ground lightning strikes had been recorded near the helicopter. "The physics of lightning is far from perfectly understood, but it would appear that the event … was probably an inter-cloud or intra-cloud strike," the report said. "Such an event is frequently triggered by the presence of an aircraft."

Mast Bumping Causes Main Rotor Separation

Fairchild Hiller FH-1100. Destroyed. Two fatalities.

The commercial pilot had purchased the helicopter in Century, Florida, U.S., and was flying it to his home base in Nevada on Sept. 12, 2007, accompanied by a passenger who held a private pilot certificate for helicopters. "Following a fuel stop [in Mississippi], they had progressed approximately 180 nm [333 km] when the helicopter's main rotor and rotor hub assembly separated from the upper mast," the NTSB report said. "The helicopter subsequently entered an uncontrolled descent and impacted the ground."

The crash occurred in VMC near Hosston, Louisiana. Shortly before the accident, a witness had seen the helicopter flying at treetop level. She said that the helicopter was "not moving fast" and thought that it was going to land on the front yard of her home.

Examination of the helicopter revealed signs of mast bumping, in which the rotor head strikes the rotor mast. "Though there was evidence of a mast-bumping event, the initiating event is unknown," the report said. "Examination of the wreckage disclosed no anomalies that would have prevented normal system operation, and the [turboshaft] engine displayed evidence of rotation at the time of ground impact. The cockpit also exhibited damage consistent with main rotor contact."

Instructor, Student Wrestle for Control

Robinson R44 II. Destroyed. Two minor injuries.

During an instructional flight in Missoula, Montana, U.S., on June 14, 2008, the student pilot was turning left base to land in an open field. "The instructor noted that the helicopter was descending faster than anticipated and that 'the collective was too far down, the cyclic was too far back, and [the student] had a tight hold on both controls,'" the NTSB report said.

The flight instructor attempted to take over but could not break the student's grip on the controls. "The instructor said that no words were spoken as he struggled with the student for control of the helicopter for a period of three or four seconds," the report said.

The R44 landed hard, rolled onto its left side and began to burn. The instructor and student were able to evacuate the helicopter before it was engulfed by the fire. The report said that a contributing factor in the accident was the instructor's "failure to verbally command the student to relinquish the controls."

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Sept. 1, 2008	Bukavu, Democratic Republic of Congo	Beech 1900C-1	destroyed	17 fatal
The airplane was on a humanitarian flight when it struck a ridge on approach to Bukavu in adverse weather conditions.				
Sept. 1, 2008	Reno, Nevada, U.S.	Lockheed SP-2H Neptune	destroyed	3 fatal
The air tanker was taking off to drop retardant on a wildfire when the left jet engine and left wing caught fire. The airplane then struck power lines and crashed.				
Sept. 1, 2008	Columbus, Ohio, U.S.	Convair 580	destroyed	3 fatal
The Convair crashed in a cornfield shortly after taking off from Rickenbacker Airport for a post-maintenance test flight.				
Sept. 3, 2008	São Paulo, Brazil	Beech King Air C90B	destroyed	3 none
The King Air overran the runway on takeoff from Congonhas Airport and struck a wall.				
Sept. 3, 2008	Persian Gulf	Bell 212	substantial	7 fatal
Night visual meteorological conditions prevailed when the helicopter struck a crane while taking off from an offshore platform.				
Sept. 7, 2008	Belize City, Belize	Cessna 208B Caravan	destroyed	5 NA
The Caravan crashed in 2.0 ft (0.6 m) of water when the pilot attempted to land on a beach after the engine failed. All five occupants sustained unspecified injuries.				
Sept. 13, 2008	Bakalan, Malaysia	DHC-6 Twin Otter	substantial	14 NA
No fatalities were reported when the Twin Otter crashed into a house short of the runway while landing.				
Sept. 14, 2008	Kununurra, Western Australia	Robinson R44	destroyed	4 fatal
The helicopter crashed during an air tour flight in a national park.				
Sept. 14, 2008	Perm, Russia	Boeing 737-500	destroyed	88 fatal
En route from Moscow, the 737 either was descending to land or on a missed approach when it crashed in adverse weather conditions at 0510 local time.				
Sept. 15, 2008	Ojinaga, Mexico	Cessna 421B	destroyed	4 fatal
The airplane crashed about 100 ft below the top of a ridge during a visual flight rules flight from El Paso to Presidio, both in Texas, U.S. The Cessna had been chartered to allow Mexican and U.S. authorities to assess flood conditions.				
Sept. 19, 2008	Columbia, South Carolina, U.S.	Learjet 60	destroyed	4 fatal, 2 serious
The Learjet overran the 8,000-ft (2,438-m) runway on takeoff and struck an embankment. The pilots reportedly had attempted to reject the takeoff after a tire burst.				
Sept. 21, 2008	Villarsel-le-Gibloux, Switzerland	Pacific Aerospace 750XL	destroyed	2 fatal
The single-turboprop utility airplane crashed in a wooded area while returning to Ecuvillens after releasing 17 skydivers.				
Sept. 22, 2008	Quito, Ecuador	Fokker F28	destroyed	66 NA
The flight crew rejected the takeoff due to a fire warning. The Fokker overran the 10,240-ft (3,121-m) runway and struck a brick wall. Eight passengers were injured; the extent of their injuries was not specified.				
Sept. 25, 2008	Talbot Bay, Western Australia	Bell 407	destroyed	7 NA
The helicopter struck the water shortly after taking off from a holiday vessel. The seven occupants exited the 407 before it sank.				
Sept. 25, 2008	Bridgewater, Virginia, U.S.	Beech King Air A200	substantial	2 none
The King Air landed long, overran the 2,745-ft (837-m) runway and came to a stop in a creek.				
Sept. 26, 2008	Vineyard Haven, Massachusetts, U.S.	Cessna 402C	destroyed	1 fatal
The 402 crashed shortly after departing for a scheduled flight.				
Sept. 27, 2008	Kirke Såby, Denmark	Robinson R22	destroyed	2 NA
The helicopter crashed on a playing field during an aerial photography flight.				
Sept. 28, 2008	Capitol Heights, Maryland, U.S.	Aerospatiale Dauphin	destroyed	4 fatal, 1 serious
The crew of the emergency medical services helicopter encountered adverse weather conditions after picking up two victims of an automobile accident. The pilots diverted the flight to Andrews Air Force Base. One patient survived when the Dauphin crashed in a wooded area on approach.				
Sept. 29, 2008	Santa Fe, New Mexico, U.S.	Pilatus PC-12/47E	destroyed	1 fatal
The airplane was being delivered to Santa Fe from New York, with a fuel stop in Texas, when it crashed 4 nm (7 km) from the airport at 0440 local time.				

NA = not available

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


EASS
21st annual European Aviation Safety Seminar
Nicosia, Cyprus
March 16–18, 2009
FLIGHT SAFETY FOUNDATION
EUROCONTROL
era
european regions airline association
To receive agenda and registration information, contact Namratha Apparao,
tel: +1 703.739.6700, ext. 101; e-mail: apparao@flightsafety.org.
To sponsor an event, or to exhibit at the seminar, contact Ann Hill, ext. 105; e-mail: hill@flightsafety.org.
© Dainis Derics/iStockphoto