AeroSafety WORLD

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LEADING BEYOND THE SYSTEM

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

MAY 2008

Targeting the Top

For years, Flight Safety Foundation has been watching and commenting on criminal prosecutions associated with aviation accidents and incidents. Our goal has been to defend the essential flow of safety information that is the lifeblood of the safety programs in our industry. It is obvious to us that prosecuting the people who make the reports will reduce reporting, but now there is a new trend to deal with.

This trend became obvious at our recent European Aviation Safety Seminar in Bucharest, Romania, where a panel of noted attorneys and experts in the field pointed out that the focus of juries and judges in accident cases has been shifting away from front-line employees. Recent cases, the panelists said, have been directed at establishing negligence on the part of companies, managers and even corporate boards.

There are more than a few recent examples. Last year, in the trial arising from the July 1, 2002, midair collision over Überlingen, Germany, none of the first-line controllers were convicted, but four managers for the air traffic control service provider were convicted for introducing negligent and potentially dangerous working practices.

Just this past March, six Crossair managers were indicted by Swiss prosecutors in connection with the November 2001 Avro RJ100 crash near Zurich Airport for "having employed a pilot with known shortcomings who caused the crash through faulty conduct."

Also in March, judges presiding over a civil suit arising from the August 2006 Comair runway-confusion accident in Lexington, Kentucky, U.S., ruled that confidential voluntary reports contained in the company's Aviation Safety Action Program could be used in court. The ruling was made in response to plaintiffs' assertions that airline management had failed to address serious safety problems and that management's lack of action constituted "a gross and wanton disregard for safety."

On April 6 in the U.K., a new "Corporate Manslaughter and Corporate Homicide Bill" took effect. It supersedes a statute that tasked juries to consider if corporate actions were "so negligent as to be criminal." The new law asks if conduct of management "falls far below what could reasonably have been expected." This sends a pretty clear message. When it comes to safety practices in the United Kingdom, no company can afford to be much below average.

This trend puts those of us in the safety business in a curious position. It is difficult to say that this will discourage reporting by front-line operators. It is more likely that prosecutors will make immunity deals with front-line employees in order to get information about their employers.

Our new concern will be managing how this plays out in the board rooms. Poorly informed legal counsel and executives could use this as an excuse to stay away from voluntary reporting systems and flight data monitoring programs. Or, in a misguided attempt to limit their liability, they could limit the information retained in such programs.

That would be the wrong reaction. The right reaction is to commit to safety management. CEOs and board members should know that the future of their companies, and possibly their freedom, may be at stake. The environment is changing, with the public around the world asking for increased executive accountability. It is up to safety professionals to reach out to executives and explain that the only way to limit their liability is to manage safety in an open and effective manner — and that this could even keep some people from getting killed.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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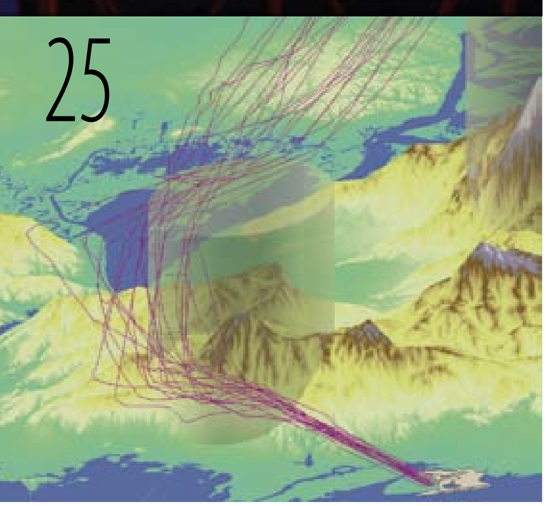

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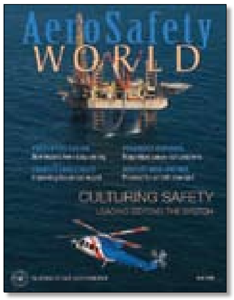

About the Cover
Going beyond safety management to a vision of zero accidents, the Bristow way.
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications J.A. Donoghue, 601 Madison St., Suite 300, Alexandria, VA 22314-1756 USA or donoghue@flightsafety.org.

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FLIGHT SAFETY FOUNDATION
SINCE 1947

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

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LOWERING The Bar

Success has its rewards, but some are less clear than others. Take, for example, the record of aviation safety in the United States, a nation where 49 people have died in a single jetliner accident in nearly seven years.

Everyone connected with aviation should be justifiably proud of that record but remain unsatisfied that accidents continue to occur and people continue to die. Yet, the success we claim in minimizing the risk of an accident has not translated into increased public confidence. Instead, we've succeeded in lowering the bar for public fear. Where once an accident was needed, or at least a very close call, to set off calls for system reform and regulator clampdowns, accompanied by expressions of public fear, now all it takes is a misconnect in compliance with an airworthiness directive (AD).

For those without access to U.S. news, the recent uproar began when the Federal Aviation Administration (FAA) proposed a fine against Southwest Airlines for failing to comply with an AD, a failure the airline reported. The issue quickly spiraled into examinations of the entire regulatory oversight system, the honesty of the people in that system and the close relationship between the regulators and the regulated.

There is no doubt that something went awry. And it happened at a time when various groups were looking for an issue with which to gain attention or advantage. The general media took what they were given and ran with it. Even Kate Hanni, lately notable as leader of a consumer group protesting airline service, was quoted as saying, "People are afraid."

That kind of attitude is a reflection of the reality that everyone in aviation must learn to live with: Travel through the air still is a novel and alien experience. Many people remain very uncomfortable with the feelings, sounds and sights associated with air travel, a discomfort that escalates into full-blown fear with the slightest provocation.

Not only do we have to learn to live with this reality, we must use it to strengthen our safety efforts and resolve to minimize risk and devise mitigations to prevent accidents, and that is all good.

However, a great risk faces the U.S. industry at this point: The U.S. Congress has become heavily involved in the discussion. With elections on the horizon, those in Congress engaged in this issue know they must discuss the situation in simplified ways that voters can easily grasp; and, in trying to show leadership, they feel the need to propose solutions of a similar nature. These solutions include ideas that would be a return to traditional hierarchical systems over the far more effective cooperative systems that have produced such fantastic results, a devolution of the safety culture that would be a real threat.

While some individuals in the system may have failed, the ideas and the procedures developed over the past several decades, and especially the past 10 years, absolutely have not failed. Some well-conceived adjustments may be beneficial, but the safety community must come together to weather the current storm in a way that doesn't cause lasting damage to the cooperative nature of a highly effective aviation safety system.

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

Is MPL a Dangerfield?

I would like to congratulate *AeroSafety World* for recognizing and reacting to the emerging aviation safety threats ("Shifting Focus" by J.A. Donoghue and "Beyond Technical" by William R. Voss; *ASW*, 12/07, p. 1 and p. 16, respectively).

"Go or No-Go" (*ASW*, 12/07, p. 28) by Oddvard Johnsen was also excellent.

It was interesting to see an article on the multi-crew pilot license (MPL) program ("Zero Time to First Officer" by Wayne Rosenkrans) in the same issue (p. 38). The program deserves the scrutiny it is undergoing, which made the InSight article "Quality Control for Pilots," by Constance Bovier (*ASW*, 3/08, p. 24), a timely report. Neither article gave much credit to real-world experience, which seems to have become the pilot-qualifications version of the late comedian Rodney Dangerfield's complaint, "I don't get no respect."

The Alteon representative's hypothetical suggestion that an MPL-trained first officer might be as good a choice (or better?) for an airline first officer position as a 1,000-hour pilot flying a cargo turboprop at night got my attention. It seems to me to be contrary to accident investigation lessons learned over the past 20 years or so, which, I believe, generally indicate that real-world experience is a good thing.

Therefore, Alteon's discounting of flight experience, which has also been expressed by other advocates of the MPL program, is interesting. All other factors being equal, and assuming the 1,000-hour pilot had completed airline training in the airplane to be flown on the line, I would suggest to Alteon and other MPL advocates that the 1,000-hour night cargo pilot might very well be a more desirable candidate than the 250–300 mostly-simulator-hour MPL graduate.

Real nighttime all-weather experience in any airplane is quite different from accelerated basic flight and crew resource management (CRM) training in ground training devices, and provides an intensive opportunity for a pilot to develop his or her skills in survival, airplane handling, decision making, risk evaluating and crew coordinating where it truly matters — in actual flight.

The product of the MPL programs as currently described will be first officers whose qualifications consist primarily of passing basic flight-training check rides in a simulated, risk-free environment, plus the receipt of heavy doses of CRM coursework. Does this emphasis on simulation and CRM justify a "Rodneying" (de-emphasis) of real-world experience? In airplanes requiring two or more cockpit crewmembers, is the resulting workload on the pilots-in-command — as their new first officers take their initial steps into the real world of aviation — fully understood and addressed?

The MPL advocates would apparently say yes to the above questions. I hope they are correct.

William C. Steelhammer

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

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

MAY 5–8 ➤ RAA Annual Convention. Regional Airline Association. Indianapolis, Indiana, U.S. Scott Gordon, <gordon@raa.org>, <www.raa.org>, +1 202.367.1170.

MAY 7–8 ➤ Aircraft Maintenance Outsourcing Expo–Europe. Aviation Industry Exhibitions. London. <www.aviationindustrygroup.com/amoeur_08>, +44 (0)20 7828 4376.

MAY 11–15 ➤ 79th Annual Scientific Meeting. Aerospace Medical Association. Boston. Russell Rayman, <rrayman@asma.org>, <www.asma.org/meeting/index.php>, +1 703.739.2240, ext. 103.

MAY 12–14 ➤ IATA Ground Operations Symposium and IGHC 2008. International Air Transport Association Ground Handling Council. Kuala Lumpur, Malaysia. <www.iata.org/events/ighs/index.htm>.

MAY 19 ➤ Safety Seminar. International Federation of Air Line Pilots' Associations. Barcelona, Spain. Arnaud du Bedat, <arnauddubedat@ifalpa.org>.

MAY 20–22 ➤ European Business Aviation Convention and Exhibition (EBACE). National Business Aviation Association and European Business Aviation Association. Geneva. <info-eu@ebace.aero>, <www.ebaa.org/content/dsp_page/pagec/ev_ebace>, +32 2-766-0073 (Europe), +1 202.783.9000 (United States and Canada).

MAY 30–JUNE 1 ➤ Australian and New Zealand Societies of Air Safety Investigators Conference. Adelaide, South Australia. <www.asasi.org/anzsasi.htm>.

JUNE 3–5 ➤ 63rd Annual General Meeting and World Air Transport Summit. International Air Transport Association. Vancouver, British Columbia, Canada. <www.iata.org/events/agm/index.htm>, +1 514.874.0202.

JUNE 4–5 ➤ Expanding Horizons: Technology Advances in Flight Simulation. Royal Aeronautical Society. London. Verna Tang, <verna.tang@raes.org.uk>, <www.raes.org.uk/conference/PDFs/578a.pdf >, +44 (0)20 7670 4372.

JUNE 8–11 ➤ Conference and Exposition. American Association of Airport Executives. New Orleans. Carrie Heiden, <carrie.heiden@aaae.org>, <www.aaae.org/products/_870_Annual_2008>, +1 703.824.0504.

JUNE 11–12 ➤ FAA Southern Region Runway Safety Summit. U.S. Federal Aviation Administration. Atlanta. Anna Cohen, <www.faa.gov/aso/RunwaySafety>, +1 404.305.5593.

JUNE 16–19 ➤ 47th Annual Convention, Trade Show and Static Display. Canadian Business Aviation Association. Toronto. Janet Maslin, <www.cbaa.ca/portal/convention>, <convention@cbaa.ca>, +1 613.236.5611, ext. 225.

JUNE 23–27 ➤ 15th International Flight Inspection Symposium: Shaping Aerospace Flight Inspection for the Future. U.S. Federal Aviation Administration and Gardner Tannenbaum Group. Oklahoma City. Mary Waggoner, <mwaggonr@ou.edu>, <www.ifis2008.com>, +1 405.325.3760; 800.203.5494.

JULY 8–10 ➤ Wildlife Hazard Management Workshop. Embry-Riddle Aeronautical University. Denver. <training@erau.edu>, <www.erau.edu/ec/soctapd/wildlife-management.html>, 866.574.9125, +1 386.226.7694.

JULY 14–20 ➤ Farnborough International Airshow. Farnborough International. <enquiries@farnborough.com>, <www.farnborough.com/intro.aspx>, +44 (0)1252 532800.

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

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

AUG. 18–21 ➤ 10th Bird Strike Committee USA/Canada Meeting. American Association of Airport Executives and Bird Strike Committee USA. Orlando, Florida, U.S. <www.birdstrike.org/meetings/2008_BSCUSA.htm>.

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

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

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

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

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

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

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

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

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

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

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

Airport Climate Change

Forecasts of a changing global climate are likely to force changes in operations at many airports, according to a study by the U.S. National Research Council (NRC), part of a private, nonprofit institution that advises the federal government on science, technology and health issues.

The major effect at airports in coastal areas of the United States will be the flooding of runways because of rising sea levels and surges that result from more intense storms, the NRC said. The problem likely will require construction of sea walls and levees to keep water off the runways or — in the most extreme cases — relocation of runways or airports.

The study identified five climate changes that will be especially important to aviation, as well as other forms of transportation, in the United States: more very hot days, increases in Arctic temperatures, rising sea levels, increases in events involving intense precipitation and increases in the intensity of hurricanes.

Safety Improvements Urged

The aviation industry in Latin America — where the accident rate is double the worldwide average — must intensify efforts to reduce accidents and coordinate safety regulations, Giovanni Bisignani, director general of the International Air Transport Association (IATA), says.

© The Boeing Co.

Data show that the 2007 accident rate in Latin America was one accident for every 600,000 flights, an improvement from the 2005 rate of one accident in 400,000 flights.

Bisignani noted that there are more than 250 safety deficiencies in Latin America with regard to standards established by the International Civil Aviation Organization. He called for increased cooperation in harmonizing safety regulations across the region and an end to divergent regulations across national borders, as well as increased use of the IATA operational safety audit (IOSA) — now incorporated into the aviation safety oversight programs of five Latin American countries.

The safety deficiencies are "unacceptable and must be improved immediately," he said. "Cooperation and a broader view based on global standards are necessary to address unique infrastructure challenges and upgrade the aging and insufficient air traffic control technology. Safety knows no borders, and safety regulation must converge again."

Accident Criminalization Denounced

The European Regions Airline Association (ERA) is encouraging European countries to adopt nonpunitive voluntary reporting systems within the aviation industry, "rather than encouraging a culture of blame and criminal prosecution, which discourages the sharing of safety information" (*ASW*, 3/08, p. 12).

The remarks by ERA President Antonis Simigdalas, the COO of Aegean Airlines, came as the Corporate Manslaughter and Corporate Homicide Act took effect in the United Kingdom in early April. The new law provides for prosecution of corporate organizations rather than individuals in cases of death resulting from failures of the corporation's senior management.


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"Prosecution is justified when it can be shown that willful disregard for established procedures, deliberate misuse of equipment, abuse of substances or anything similar has recklessly endangered the safe operation of a flight," Simigdalas said. "However, where the cause of an incident or accident is due to human fallibility and all involved have used their best endeavors to ensure the safe operation of a flight, the use of reported data for criminalization purposes acts directly against the larger public interest and the future safety of European flight operations."

Simigdalas said that a voluntary safety reporting system is crucial for accident prevention and that "all aviation personnel … must be willing to disclose and share such information and be confident that they do so without penalty or fear of prosecution."

Safety Reporting Pact

The U.S. Federal Aviation Administration (FAA) and the National Air Traffic Controllers Association (NATCA) have agreed to establish a voluntary safety reporting system — an air traffic safety action program (ATSAP; *ASW*, 7/07, p. 12).

In a joint statement announcing their agreement, the FAA and NATCA said that their goal was to encourage a "voluntary, cooperative, nonpunitive environment for the open reporting of safety of flight concerns by employees of the FAA."

The ATSAP, which resembles the aviation safety action programs in place for pilots, flight attendants, dispatchers and/or maintenance personnel at many airlines, will provide both the FAA and the controllers with access to safety information that will be analyzed to identify actions that can resolve safety issues.

"This system … lets us know immediately when we have issues," FAA Acting Administrator Robert Sturgell said. "We can dissect them together, find causes, spot trends and implement solutions. … Creating an atmosphere where controllers and their managers can identify, report and correct safety issues will go a long way in helping us further improve our safety record."

NATCA President Patrick Forrey said safety would be improved under a "systematic approach for all employees responsible for the safety of the traveling public to promptly identify and correct potential safety hazards. For the people NATCA represents, the benefits are clear: This provides us with protection from discipline when our members identify errors and other performance-related issues affecting system safety."

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Copper Pipe Failure

© Aleksandar Jovanovic/Dreamstime.com

The Civil Aviation Safety Authority of Australia (CASA) is warning operators and maintainers of aircraft with copper alloy pipes of the possibility of fatigue failure, citing a report of an in-flight failure of a copper fuel line, which led to a fuel leak and an engine failure.

Details of the incident were not available, but CASA said the fuel line failed because of "work hardening," which results from exposure to long periods of normal engine vibration, damage incurred during maintenance or over-tightening during installation.

CASA recommends periodic inspections of all copper alloy pipes and replacement of those that are damaged or that have been in service longer than 10 years or 10,000 flight hours.

Most ICAO Audits Made Public

All but six member states of the International Civil Aviation Organization (ICAO) audited in accordance with ICAO's Universal Safety Oversight Audit Programme (USOAP) have agreed that results of their audits should be made public.

"The fact that most states have authorized ICAO to go public means that they recognize the critical safety benefit of transparency," said Roberto Kobeh González, president of the ICAO Council.

"Being aware of problems in various states and of the effective solutions developed to solve them can help other states correct their own deficiencies identified under USOAP. It also makes it easier for states and donors to cooperate in providing assistance where needed and helps the public make informed decisions about the safety of air transportation."

March 23 was the deadline for states to agree to have their information posted on ICAO's public Web site — <www.icao.int/fsix/safety.cfm>. The deadline was established in 2006 by the Directors General of Civil Aviation Conference on a Global Strategy for Aviation Safety. USOAP calls for "regular, mandatory, systematic and harmonized safety oversight audits" aimed at evaluating the level of implementation of ICAO standards and recommended practices by ICAO's member states, identifying safety concerns and providing recommendations for improvement.

The six countries that have not agreed to the public release of their audits are Iran, Kazakhstan, Kiribati, Sierra Leone, Swaziland and Zimbabwe. ICAO said that it "continues to strongly encourage the six states to provide their consent."

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Getting Along

A report on the relationship between the Australian Transport Safety Bureau (ATSB) and the Civil Aviation Safety Authority of Australia (CASA) has produced a series of recommendations aimed at helping the two bodies "maximize the practical contribution they are able to make to aviation safety," said Anthony Albanese, Australia's minister for infrastructure, transport, regional development and local government.

Some of the 19 recommendations address administrative matters, but others involve more complex issues, including "refining the protection of information collected during ATSB investigations, namely that in strictly limited circumstances, the information should be provided to CASA to facilitate immediate safety action," Albanese said.

Plans called for public comments on the recommendations to be accepted until April 30; final action was to come after that date.

The report said that the review of the relationship between the ATSB and CASA was ordered after friction between the two agencies became apparent during investigation of the May 7, 2005, crash of a Fairchild Metro 23 near Lockhart River in Queensland. All 15 people in the airplane were killed in the controlled flight into terrain crash, and the airplane was destroyed.

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"While cooperation and coordination in the interests of aviation safety [are] to be expected of both, there will from time to time be legitimate differences of opinion between them, sometimes creating tensions," the report said. "That they may have legitimate differences of opinion on occasion, each firmly held, is not a matter of surprise or concern. It is how they deal with those differences that is important."

In Other News …

Swiss researchers say they have used mathematical and computer techniques to develop a sophisticated simulation of aircraft **wake turbulence**. They say the simulation will improve understanding of the physics of wake turbulence and thereby aid in aircraft construction. … Officials in Australia are considering a proposal to establish a national database of **power lines**, tall buildings and other low-level flight risks. The Energy Networks Association said after initial discussions with the Australian Transport Safety Bureau and Geoscience Australia that the proposal would be considered as one of this year's priority issues. … The U.S. National Transportation Safety Board (NTSB), citing the 2006 collision of a Raytheon Hawker 800XP and a Schleicher ASW27-18 glider near Reno, Nevada, U.S., has recommended requiring some **gliders** to be equipped with transponders. The NTSB said that the U.S. Federal Aviation Administration should end gliders' exemptions from regulations requiring transponder use.

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Airport Moving Map

Jeppesen has received approval from the U.S. Federal Aviation Administration for its airport moving map application for Class 2 (portable/fixed mount) electronic flight bags (EFBs) — the first company to receive approval.

The moving map uses global positioning system (GPS) technology to show pilots their aircraft's position on an airport surface. About 200 commercial airports worldwide are included in the database.

Jeppesen's airport moving map has been in use for nearly five years on Class 3 (installed) EFBs. The company says approval of the Class 2 application will enable the retrofitting of a number of aircraft.

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Correction

Several paragraphs of "Working to the Limit," beginning on p. 14 in the April 2008 issue of *AeroSafety World*, were inadvertently repeated or eliminated. The correct version of the article is available on the Flight Safety Foundation Web site at <www.flightsafety.org/asw/apr08/asw_apr08_p14-18.pdf>.

Compiled and edited by Linda Werfelman.

Beyond Safety Management Systems

Leadership and safety culture play essential roles in moving an organization beyond rote subscription to an SMS.

BY ANDY EVANS AND JOHN PARKER

A truly safe operation is not defined simply by the presence of a safety management system (SMS). While an SMS is a good start, more is needed, much more.

The International Civil Aviation Organization's (ICAO's) decision to require aviation organizations to adopt SMSs has clearly focused attention on the concept of an SMS. However, a decision was made at Bristow Group to expand the effort and set an ambitious goal.

The letters in the abbreviation "SMS" neatly explain the why, what and how of the concept:

- *Why* have an SMS? To help achieve your Safety vision.
- *What* does an SMS do? Provides a means to Manage the processes needed to achieve your safety vision.
- *How* does it do this? By being an organized, Systematic approach.

It is important to have a safety vision. For some organizations, the vision is an accident rate they deem acceptable. Others set future improvement targets based on their previous performance or industry benchmarks, and some organizations believe that every accident is preventable and their vision should be zero accidents. Each philosophy has its merits, but without a vision, it is impossible for those within an organization to

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TARGET ZERO
The Bristow Group Culture of Safety
Zero accidents.
Zero harm to people.
Zero harm to the environment.

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have a common understanding of what they are trying to achieve.

The idea that an SMS is systematic is also important. Even if an organization has all the key safety activities in place, unless these activities are integrated systematically, key information can be overlooked, foiling effective decision making. Organizations adopting an SMS need to ensure they are looking at all their risks and at their organization as a single system, rather than having multiple competing safety management "silos."

Managing safety in silos is dangerous because it can hinder proper improvement action prioritization or even hide important issues from management attention. In the case of an oil refinery at Texas City, Texas, U.S., the focus on occupational safety issues came at the expense of attention to process safety in the run up to a fatal explosion in March 2005.[1] In another case, greater attention to flight safety in the Royal Australian Air Force masked a 22-year problem in which workers who maintained F-111 fuel tanks were being exposed to hazardous chemicals that caused memory loss, fatigue and other neurological problems.[2] These resulted in a board of inquiry and an AUD$21 million compensation package. Smaller examples are common when flight operations, engineering, ground handling safety and so forth are considered separately, or when subcontractors are excluded from the overall safety management process.

The antidote to such silo thinking is the proper evaluation of all risks, a key aspect of an effective SMS. Unfortunately, some aviation operations hold on to the misconception that "risk" is a rating applied after incidents occur. Organizations suffering from this misunderstanding are doomed to be constantly surprised by new incidents and even accidents that they do not expect or have adequate controls to prevent. As a result, they become blindly reactive. Proactive organizations embrace the proper use of risk management within their SMS, realizing it is a valuable way to prevent accidents and prioritize investments in safety.

It has been noted that while the compilation of ICAO's 290-page *Safety Management Manual*[3] is a huge achievement, it is not a concise guide.[4] It has also been observed that "SMS courses generally focus on principles, concepts and general advice," and that there is a hazard of "rejection of SMS due to confusion and frustration" because of the contrasts between such abstract descriptions of SMS and practical implementation.

Too often, the method used to concisely describe an SMS consists of a long "laundry list" of SMS components, almost like the contents page from an organization's SMS manual. Such lists give no clue of how to combine these components into a functioning system. This may explain why some implementations have tended to be piecemeal rather than systemic.[5] This is disappointing; quality management systems have been common for many years and the SMS concept is simply a focused application of such management system principles to safety. Encouragingly, some regulators are now accepting that there are simpler, clearer models, and that there is no single idea model or format for an SMS.[6]

Our safety approach at Bristow is to use a simple, practical but powerful four-element model based on three processes that feed a fourth.

The first process is risk management, a proactive, predictive process. This process is first used during planning that precedes launching a new venture or when implementing changes. The aim is to identify hazards, determine how they need to be controlled and decide if the resultant risks are acceptable. If any risk is not acceptable, the planned activity should not be permitted unless a different control strategy is utilized. Risk controls must also be re-evaluated when the second or third processes highlight possible problems. Risk management still is uncommon in the aviation industry, which previously has relied on regulations to determine what practices are safe. It remains to be seen how regulators deal with the greater self-determination that the SMS concept introduces.

The second process is monitoring. Also proactive, this involves examining operations to identify opportunities for improvement and latent weaknesses in controls before they result in adverse consequences. This process can include flight data monitoring, crew resource management, scheduled maintenance inspections, surveys, routine supervision and many other techniques. One of the most powerful monitoring tools is good independent auditing, an effective way to avoid complacency and highlight slowly deteriorating conditions. Bad audits simply seek to confirm the existence of controls required by regulations; good audits look at how effective the controls are in practice and whether the control strategy is appropriate.

The third process, safety reporting and investigation, is purely reactive after things have gone wrong, often only after an accident or an incident reveals that safety margins have been eroded.

These three processes each provide a unique point of view:

- Risk management is predictive and provides foresight;
- Monitoring is proactive and provides oversight; and,
- Safety reporting and investigation are reactive and provide hindsight.

Risk management offers the greatest efficiency and cost benefit, needing fewer resources than monitoring. However, monitoring is still essential to detect weaknesses and is very effective.

The most inefficient of the processes are safety reporting and investigation because, at best, safety margins have degraded and risk has increased to a level sufficient to cause alarm. At worst, a major loss has occurred.

The aim should always be to prevent weaknesses in the system before the third process is required. The ultimate justification for this diligence is to support the company's health. It has not gone unnoticed that all three airlines involved in fatal accidents in Australia since 1990 have gone out of business.[7]

One management challenge is to ensure sufficient attention is paid to the results of risk assessments and audits and not to assume that a lack of accidents yesterday means all is well today. These three processes combine to provide integrated, comprehensive insight into operations.

How Insight Is Created

Insight is achieved through management review of operations. Once gained, insight ensures that management makes full use of all predictive, proactive and reactive activities to deliver effective improvements.

Although the first three processes all create immediate improvement actions based on lessons learned, the main purpose of management review is to create strategic improvements. There should be regular communication and reviews of the results of risk assessments, monitoring — in particular independent audits — and safety investigations to ensure that action is being taken, supplemented by regular senior management meetings on safety matters.

While this management review usually is facilitated by the organization's safety staff, it is vital that the organization's senior managers accept that they are accountable for the safety performance of their organization and therefore must have control of safety decision making, using all available information and making the right resources available. Sadly, it is this critical management governance activity that usually is neglected by organizations that take a piecemeal approach to implementing their SMS. This neglect undermines the whole SMS.

Bristow Group and Target Zero

Bristow Group is the world's leading provider of helicopter services to the oil and gas industry. Bristow is also an experienced provider of search and rescue (SAR) services and, through the Bristow Academy, flight training. The company operates around 400 aircraft in more than 20 countries on the U.S., Trinidadian, U.K., Nigerian, Turkmen, Russian and Australian registers. This fleet flies around 300,000 hours each year in a range of demanding environments. FB Heliservices (a Bristow joint venture with the Cobham Group) provides a range of aircraft and services to the U.K. military. Additionally, Bristow has its own design and production capability to develop safety and role-specific modifications. This unique multinational operational portfolio means that the company is exposed to the latest safety thinking in the aviation industry, the energy sector and the military.

Bristow is already an industry leader in safety performance. Over the past five years Bristow's air accident rate has been less than 40 percent of the average for all operators providing the very demanding support for the oil and gas industry worldwide.

In September 2005, at the first International Helicopter Safety Symposium, an industry commitment to making an 80 percent reduction in helicopter accident rates over 10 years led to the creation of the International Helicopter Safety Team (IHST; *ASW*, 1/08, p. 28). Although Bristow is a committed member of the IHST, when Bristow considered its own safety vision the company settled on the more demanding vision of operating without accidents and without harm to people or the environment. That vision was summed up in two words, "Target Zero."

That vision was accompanied by its own logo, with a tagline associating that vision with a "culture of safety." To build a global Target Zero culture of safety it was decided to market Target Zero in a high-quality campaign, making "Target Zero" our shorthand for safety. Similarly, the simple but distinctive logo was designed to be a graphical representation of the safety vision.

Some might think that zero is an idealistic but impossible target in a high-hazard industry. However, Bristow believes that accidents do not just happen but are "caused." Target Zero sends the signal that accidents can and should be prevented and that there is a duty to strive not only to reduce risks as low as practical but also to establish new ways to reduce risk. To back up this vision, a more specific set of safety beliefs, commitments and expectations was developed, along with a leadership charter, to help guide managers and employees.

The final step before starting to communicate the Target Zero message was to conduct a global survey in 2006 across all operations to get a baseline assessment of our employees' safety perceptions.

In early 2007, the Target Zero vision was launched. A group of more than 500 managers, supervisors and others in positions of influence took part in a series of 24 safety leadership workshops. Twenty were held in just seven weeks in nine locations in the U.S., Trinidad, U.K., Nigeria and Australia to generate a high level of momentum, with four more added to satisfy subsequent demand.

The aim in these workshops was to enhance leadership skills so the participants could:

- Confidently convey the Target Zero message face-to-face to their own teams;
- Seek some tangible safety improvements to demonstrate commitment; and,
- Take the lead on safety by example and hold their own teams accountable for their safety behavior.

As well as explaining the Target Zero concept, each two-day workshop covered coaching and leadership skills, featured a safety decision-making exercise, an accident case study, a description of our key SMS principles and a physical team exercise to practice safety leadership. To show that these workshops were designed to be just the first stage of an ongoing process, participants had to develop their own Target Zero implementation plans that would make a difference in the workplace. They were supported with a range of briefing and campaign materials.

During these workshops, the idea was developed for an award winning poster campaign, which emphasizes the expectation that people "see the dangers, say something, listen and take action."

At the end of 2007, Bristow ran its second safety survey. The experience with the first survey enabled major improvements to be made in-house for the second survey, which helped to increase participation dramatically. This survey gave good feedback on both the successes and further opportunities for improvement.

During 2008, a major new element will be the development of a network of Target Zero Champions to facilitate specific safety improvement campaigns. Their first project will be to roll out an enhanced version of Bristow's behavioral-based safety scheme. They will train all employees to make safety observations and interventions to reinforce safe behaviors and eliminate risky behavior. This is an important way to encourage safety leadership at all levels. Linked with this, Bristow will be introducing a means to reward and recognize proactive safety efforts to further reinforce positive safety behavior.

At the end of 2008, we will repeat the safety survey and measure the change, as we cannot hope to control what we don't measure.

— AE and JP

While an effective SMS helps create a pro-safety environment, we don't believe it can be the primary means to influence culture.

Insight is also important as the source of safety promotion and awareness information for all employees and subcontractors. Insight may be communicated through training, safety meetings and briefings, notices, newsletters, and company intranet sites. Learning needs to be embedded in the organization's procedures.

Another way to see how the processes fit is by examining a plan-do-check-act (PDCA) cycle (Figure 1), a common feature of most management systems.

The Processes Combine in PDCA Cycle

One observer has written:

> *The systematic application of safety management principles, culminating in the formal assurance that the goals can and are being achieved, can significantly help to achieve high levels of safety. … A safety management system … is never enough if practiced mechanically; an SMS requires an effective safety culture to flourish.*[8]

Organizations that introduce an SMS prior to any regulatory requirement have the advantage that while they continuously improve their SMS they can now look beyond SMS to developing their safety culture. Indeed, it is a paradox of the SMS concept that if you only want one because it is a regulatory requirement you probably have a weak safety culture and will be unable to take full advantage of SMS benefits.

Plan-Do-Check-Act Cycle

Source: Bristow Group

Figure 1

Safety Culture

The term "culture" began to be used in relation to organizations in the early 1980s. "Safety culture" started to become widely used after an International Atomic Energy Agency report discussed the concept in 1988, following the Chernobyl reactor accident.[9] There have been many academic debates over what constitutes a corporate culture in general and a safety culture specifically.[10] There has also been sound research on the observable signs that allow cultures to be classified,[11] and critical components of a safety culture have been identified such as reporting, just, flexible and learning elements.

One definition of "culture" that is sometimes used is that it's "the way that we do things around here." Such a simplistic description can lead to confusion, as it implies that culture is a combination of what an organization's procedures state — when the procedures are followed — and what violations occur — when the procedures are not followed. Those who use this interpretation often conclude that an SMS is the primary means of obtaining the desired safety culture. They misguidedly believe that the necessary commitment to a safety vision — in some cases even distorted into a commitment to the SMS itself — can be expressed simply by the CEO signing a one-page preface to their SMS manual.

We believe that culture is an attribute of an organization and its collective values, beliefs, expectations and commitments that affect individual behavior at all levels. While an effective SMS helps create a pro-safety environment, we don't believe it can be the primary means to influence culture.

The greatest cultural concern for management of any safety-conscious organization should be how that group influences the organization's culture to be a positive influence, a "culture of safety." How to do this is rarely explained by research into safety culture. We believe that to influence culture you need more than an SMS.

We are convinced that the main way to develop a proactive and mindful "culture of safety," a culture that will be able to take full advantage of the SMS concept, is through leadership.

Management and Leadership

Management and leadership are fundamentally different activities. It has been said that management is about coping with complexity whereas leadership is about coping with change.[12] While managers are appointed, leadership is not linked to one's position in the organization but to influence. Leadership needs to be visible, focusing more on people, building trust and ultimately influencing their behavior, but management focuses more on data, analysis, control and scheduling of resources.

It is important to understand that although different, these complementary activities are both vital to the safe and successful functioning of any organization. A vision for the future of an organization cannot be achieved without a combination of management and leadership.

In the model of the relationship between leadership and management (Figure 2), there are links between strategy and culture, goals and teamwork, and tasks and people. These links emphasize that management and leadership activities must be aligned. In particular, leaders need to carefully consider the insight provided by their SMS, so that they lead their organization in the right direction, promoting the continuous improvement of processes and the development of their people.

When prospective leaders do not understand the culture in which they are embedded, it is the cultures which can control them.[13] While improving a culture is a long-term project, destabilizing a culture can be an unintended consequence of just a few misguided words or actions. As one researcher wrote:

> *When leaders walk into the workplace they see the behavior of their people, but they also see reflected in them their own behavior.*[14]

The development of safety leadership skills is regarded as essential in forward-thinking organizations. However, we believe that everyone can be a safety leader. This means that the development of safety leadership skills cannot be limited to senior managers. Appropriate training and development needs to be applied across an organization.

Conclusions

It is a concern that even by late 2007, as few as 10 percent of airlines had a "reasonably implemented SMS," according to ICAO's Capt. Daniel Maurino.

Organizations need to ensure that their SMS is a truly embedded, systematic, integrated and holistic system. They need to be able to clearly demonstrate how their SMS functions as a system rather than describing individual components.

By clearly identifying safety culture as something that must be handled in a way different from an SMS, and adding the "secret ingredient" of leadership to build a strong culture of safety, leading organizations can both make their SMS even more effective and continuously improve to achieve demanding safety visions. ●

Leadership–Management Relationship

Source: Bristow Group

Figure 2

Andy Evans is Bristow's global quality and safety standards manager. John Parker is quality and safety manager for Bristow's eastern hemisphere operations.

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Pilots at several airports have reported navigation problems that involve erroneous heading information. Authorities blame magnetic anomalies in areas on the ground.

AIRPORT MAGNETISM

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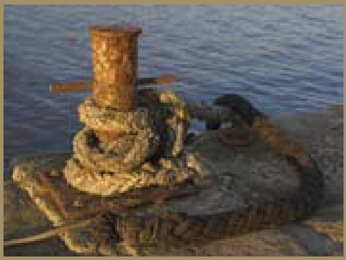
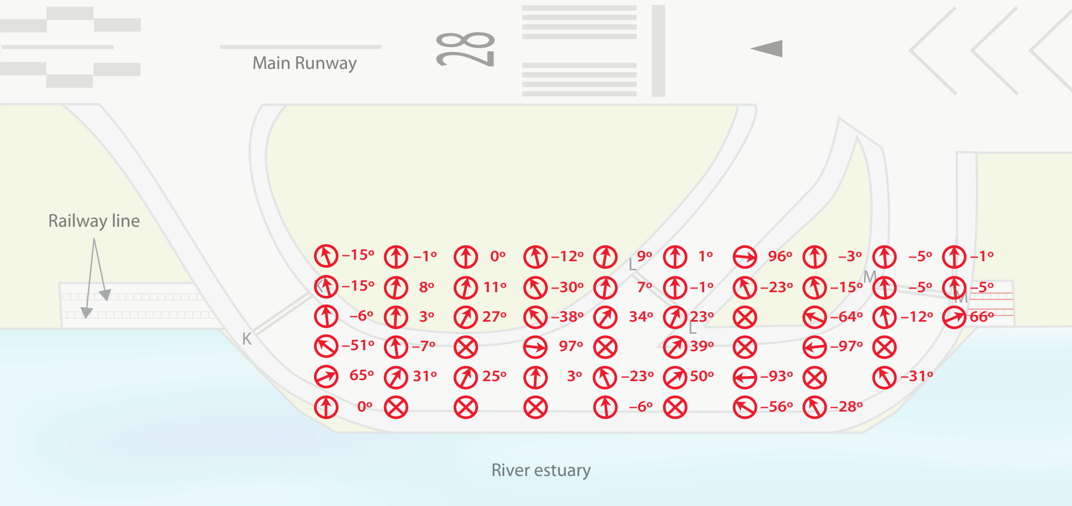
BY LINDA WERFELMAN



At London City Airport, the remains of bollards like this one have been linked to magnetic anomalies and aircraft navigation problems.

Results of Compass Deviation Study



Note: Numbers indicate the degree, plus or minus, of compass deviation. The symbol "⊗" indicates that magnetic field deviation in this area was too strong for measurement.

Source: U.K. Air Accidents Investigation Branch

Figure 1

Magnetic anomalies in runway holding areas have caused events involving significant navigation problems for aircraft departing from several airports in Europe and the United States, a report by the U.K. Air Accidents Investigation Branch (AAIB) says (see "When North Becomes South …" p. 20).

The AAIB report focused on an Oct. 31, 2006, event in which the crew of a Raytheon Hawker 800XP, after departure from London City Airport (LCY) for a flight to Brussels, Belgium, observed a 60-degree difference between headings indicated on the two primary flight displays (PFD 1 and PFD 2), and a 15-degree difference between the heading displayed on PFD 1 and the combined standby instrument. Red FD flags appeared on the PFDs, and both flight directors were "unavailable," the report said.

The pilots, in compliance with the emergency procedures section of the quick reference handbook, selected AHRS 1 (attitude and heading reference system 1) as the source for both sets of flight instruments. After 10 minutes, the problem had not been resolved, and the pilots — the only people in the airplane — received radar vectors for their return to LCY.

Earlier, on the ground at LCY, the pilots had observed AHRS and HDG (heading) red flags on both PFDs, indicating that heading indications were unreliable, the report said.

"The pilots commented that this was a 'known fault' at LCY which they thought was associated with 'metal in the taxiway pilings,'" the report said.

When North Becomes South …

Earth, with its core of iron and nickel, behaves like a spherical magnet, surrounded by a magnetic field that resembles the magnetic field associated with a dipole magnet — that is, a magnet with a north pole and a south pole.[1,2]

The magnetic field varies in intensity from place to place and also over time. The U.S. National Geophysical Data Center (NGDC) says that the intensity is so irregular that "it must be measured in many places to get a satisfactory picture of its distribution." Measurements of its intensity, and various components of intensity, along with other factors, are obtained via satellites, at about 200 magnetic observatories around the world.

A device called a dip needle identifies the north magnetic pole as the place where the north end of the needle is down; at the south magnetic pole, the north end of the dip needle is up.

Slow changes in the measurements indicate that magnetic field strength may be declining, and that the magnetic poles are moving.

Data indicate that, over time, Earth's magnetic field has been through cycles of strengthening and weakening, and that its polarity has changed — that is, the north and south magnetic poles have reversed.

"Based on measurements of … Earth's magnetic field taken since about 1850, some paleomagnetists estimate that the dipole moment will decay in about 1,300 years," the NGDC says. Even if a reversal begins, "it would still take several thousand years to complete. We expect Earth would still have a magnetic field during a reversal, but it would be weaker than normal, with multiple magnetic poles."

The consequences? "Radio communication would deteriorate, navigation by magnetic compass would be difficult and migratory animals might have problems," the NGDC says.

— LW

Notes

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The red flags disappeared as the airplane was lined up on Runway 28, but after departure, the pilots could not control the airplane's heading while using the autopilot "because neither of the heading selector bugs would move in response to rotation of the heading selector control."

During the investigation, the AAIB was told of several similar events that had been detailed in mandatory occurrence reports (MORs) submitted to the U.K. Civil Aviation Authority (CAA) by operators and air traffic controllers at the London Terminal Control Centre. The MORs described navigation problems experienced by the crews of Hawker 800s, Cessna Citations and Fokker 50s after departure from LCY's Runway 28.

"The first such occurrences, mostly to Fokker 50 aircraft, were attributed to poor compliance by pilots with assigned routings," the report said. "An ATC [air traffic control] Occurrence Report into an incident on 23 September 2003 noted that failure to follow the correct SID [standard instrument departure] route was 'an increasingly regular occurrence' involving aircraft departing Runway 28 at LCY."

The CAA responded to the series of MORs with an investigation of the possibility of problems involving the London VOR (VHF omnidirectional radio). No problems were found.

The AAIB investigation examined the history of LCY, which opened in 1987 on the site of what once was a shipping dock. Railway lines had run between two rows of warehouses; only some of the lines were removed before construction of the airport.

In addition, large cast iron bollards — used to tie up ships — had been mounted along the dock walls. The report said, "These bollards were similar to icebergs — what was visible above the dock wall was about a fifth of the size of what was below the wall." When the airport was built, the sections of the bollards that were above the dock wall were removed, but the sections below the wall remained.

In 2003, an aircraft holding area was built atop numerous steel-encased concrete piles that had been sections of an out-of-service oil pipeline. The area included old railway lines and lower sections of cast iron bollards, neither of which were removed.

"A walk around the Runway 28 holding area with a hand-held magnetic compass by an AAIB inspector showed that there were some large and strong magnetic anomalies that made the compass needle deviate by up to plus or minus 60 degrees," the report said.

Engineering surveys were conducted within the Runway 28 holding area, 1.4 m (4.6 ft) above the surface, to measure "magnetic signature" — characteristics including the intensity and orientation of the magnetic field at a specific site — and compass deviation — the number of degrees that a magnetic compass deviates from magnetic north — at dozens of points within the Runway 28 holding area. The survey found compass deviations of as much as 97 degrees (Figure 1, p. 19).

The surveys concluded that the compass deviation problems at LCY are "caused by several ferrous magnetic signature anomalies, primarily emitted as a vertical component from the 68 piled-beam structures situated under [the] Runway 28 holding area."

In addition, the surveys identified other sources of magnetic anomalies from the remains of the bollards under the holding area, from steel-reinforced concrete in the holding area and from the railway lines below the holding area.

Problems Elsewhere

AAIB investigators found that similar occurrences had been reported at several other airports, including Stockholm Arlanda in Sweden, George Bush Intercontinental Airport (IAH) in Houston and LaGuardia Airport in New York.

At Stockholm Arlanda, pilots reported compass deviations while taxiing to Runway 01/19, the report said, and a subsequent investigation found that magnetic anomalies were to blame.

The report said that, during refurbishment of the taxiway, it was found that steel nets that had been used for pavement reinforcement were "notably harder to bend than the material commonly used for this purpose, and exhibited permanent magnetism." The AAIB quoted a Swedish report as saying that there were no magnetic anomalies associated with the steel nets usually used for reinforcement "but that permanent magnetic steel nets constituted a significant source of interference."

No further problems were reported after the runway was refurbished, the report said.

At IAH, published information warns of magnetic anomalies that may affect compass heading immediately before, during and after takeoff on Runway 15L/33R and on two taxiways, the report said.

"When contacted by the AAIB, a representative of the airport operator commented that he thought that IAH was the only airport with this problem," the report said. He said that the anomalies were first observed after the airport blasted small steel balls against the surface of Runway 15L to remove paint and rubber.

"The impact of the steel balls with the runway surface had magnetized the steel reinforcement embedded in the concrete," the report said. "Subsequently, aircraft with flux valve detectors mounted in the wing tips would experience a magnetic deviation of between 40 degrees [and] 90 degrees. Several aircraft aborted their takeoffs. Those that departed either returned to the airport or regained normal compass indications shortly afterwards."

The airport operator's attempt to neutralize the magnetic field in the area was "partially successful," the report said, and the magnetic anomaly dissipated with time. Pilot awareness of the risk reduced the frequency of occurrences, and "there have been no further reports for several years," the report said.

The AAIB report cited a description of the LaGuardia problem that was the subject of a report submitted in April 1994 by a first officer on an unidentified aircraft to the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS). The first officer said that, during a takeoff roll on Runway 31, the crew observed an erroneous reading of 350 degrees on both of the airplane's horizontal situation indicators (HSIs) and its two radio magnetic indicators (RMIs). The crew re-set the instruments, and further operations were normal, the report said.[1,2]

"We learned later that the gate we had parked at prior to our departure had produced gross compass swings in the past on some aircraft," the first officer's report said. "Evidently, some magnetic anomaly is present there, producing as much as 40 degrees of compass swing. A subsequent rapid departure does not give the compass system time to re-sync to the correct heading, and if the crew doesn't catch it, a problem after departure can develop."

The first officer's report said that the operator had subsequently warned its pilots about the possibility of

compass problems at that particular gate. The AAIB report said that the airport operator had not said whether any remedial action had been taken.

Another pilot — a captain on a McDonnell Douglas MD-80 — had filed a similar report with ASRS about an event in January 1994.[3]

In this report, not cited by the AAIB, the captain said that, although the HSI compass heading had been "reasonably normal" when the airplane was in position on Runway 13, during the takeoff roll, "I noticed briefly what appeared to be a 15-degree to 20-degree heading split. With our flight directors and autopilot unusable at this time, we continued our takeoff and departure."

He said that the crew considered rejecting the takeoff but continued because weather and visibility were good and the problem was expected to be brief.

"All takeoffs from Runway 13 at LaGuardia that I have made recently have had compass problems — magnetic deviations," he said. "I am sure that I am not the only [pilot] to have had these problems. … Under bad weather/visibility, this can be dangerous."

The ASRS report said that Runway 13 and Runway 22 — where the captain said he had experienced similar anomalies — are constructed, in part, on steel and reinforced concrete piers.

The AAIB report said that, although magnetic anomalies have been reported at airports around the world, LCY has been the scene of the greatest number of reported events.

One operator of Hawkers and Citations that were involved in a number of the events subsequently issued memos to its pilots, describing the techniques to be used in its various aircraft to cope with the problem.

The AAIB said that, when flight crews have complied with recommended procedures, a "temporary residual deviation" sometimes has continued to affect aircraft operations but typically has not interfered with the aircraft's ability to follow an assigned route.

"In cases where deviations from the assigned route became problematic for pilots and ATC, it is likely that the condition was exacerbated by the manner in which the crew dealt with the anomaly," the report said.

For example, in some cases, crews have not completed the recommended procedures before takeoff, and as a result, "the heading reference system was not in a mode which could provide meaningful heading information," the report said.

The report characterized as "severe" the effects of local magnetic anomalies on Earth's magnetic field at some points within holding areas at LCY.

"Most aircraft have magnetic flux valves fitted on the undersides of the wing tips … [to] sense … Earth's magnetic field and by electrical/electronic circuitry, realign the aircraft's compass systems," the report said. "An electrical limiter is installed into the flux valve system that limits the rate of realignment of the aircraft's compasses to, generally, 3 degrees a minute. This allows aircraft to transit areas of magnetic anomalies at airports without any significant realignment input into the compass systems. However, if an aircraft is stationary in an area of magnetic anomaly, then the amount of compass realignment is directly proportional to the length of time that the aircraft is stationary and the strength and orientation of the magnetic anomaly in that area. … At [LCY], an aircraft that is stationary at Hold M for 10 minutes could have both compasses realigned by up to 30 degrees — the P1's 30 degrees to the left and the P2's 30 degrees to the right. Once the aircraft leaves the hold [area] and enters the runway for departure, it could take up to 10 minutes for the compasses to realign to magnetic north."

No International Requirements

The investigation revealed that no national or international requirements exist for evaluation of the effects of magnetic anomalies at airports or for mitigation of those effects, the report said. As a result of the investigation, the AAIB recommended that the International Civil Aviation Organization amend Annex 14, *Aerodromes*, "to highlight the importance of ensuring that no airport infrastructure is allowed to alter significantly the local Earth's magnetic field density in areas where aircraft hold prior to departure."

The AAIB issued similar recommendations to the European Aviation Safety Agency and the CAA, calling on them to require action by airport operators.

Other recommendations said that the CAA should publish a warning about the magnetic anomalies at LCY in an amendment to the Aeronautical Information Package, should require LCY to "mitigate the effects of the magnetic anomaly," and should require operators at LCY to provide their pilots with information on the problem and pilot procedures for mitigating its effects. The CAA accepted the recommendations. ●

This article is based on U.K. AAIB Aircraft Incident Report No. 1/2008 (EW/C2006/10/10).

Notes

1. NASA ASRS. "Magnetic Mystery." *Callback* No. 190 (February 1995).
2. NASA ASRS. Report no. 269103. April 1994.
3. NASA ASRS. Report no. 260698. January 1994.

Contaminated Air TIME TO ACT?

BY SUSAN MICHAELIS

Many people within the airline industry continue to suggest that cockpit/cabin fumes events involving synthetic jet engine oils and hydraulic fluids are rare, perceive them as a nuisance rather than as a threat and therefore discount them as an aviation safety issue. This perception is not supported by the evidence. Others argue that more scientific data are required, but, in fact, a wide range of well-documented sources clearly shows that it is more likely than not that there is a connection between air contaminants and health effects.

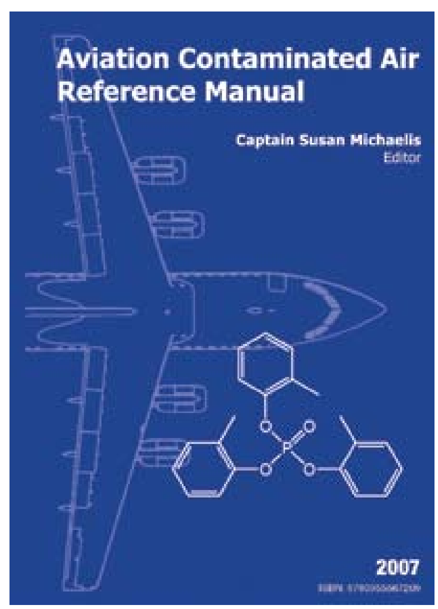
Fumes events were recognized as not being rare back in the 1970s and in the early 1980s. In 2006, the U.S. Federal Aviation Administration (FAA) expressed serious concerns that U.S. airlines were failing to report all "smoke/fumes in the cockpit/cabin" events; as such, the industry cannot truly know the scale of this problem.[1] Previous recognition that they are significantly under-reported has been supported by the Australian Senate, the Australian Transport Safety Bureau, the Royal Australian Air Force (RAAF) and the Global Cabin Air Quality Executive (GCAQE), a nonprofit advocacy group representing the interests of more than 500,000 aviation workers globally. In March 2008, the GCAQE called for a public inquiry into failures by the U.K. government, including the Civil Aviation Authority (CAA), to deal with these matters effectively.

Aviation oils and fluids typically contain hazardous substances that become toxic when heated.[2] Among those of most concern are an organophosphate anti-wear and fire-retardant compound called tricresyl phosphate (TCP), a neurotoxin, and an anti-oxidant compound called phenyl-alpha-naphthylamine, a skin sensitizer. The health hazards of inhaling their aerosols, vapors, mists, fumes or byproducts via the environmental control system (ECS) have been recognized since the 1950s.

The first published case of aircrew incapacitation in flight — involving disturbances in mental and neuromuscular functions caused by inhalation exposure to aerosolized or vaporized oil — was reported in 1977.[3] That paper stated, "Further investigation into the potential hazards from inhalation of synthetic oil fumes that are generated by these circumstances is definitely warranted." To date, adequate research has not occurred.

In addition to aircraft systems failures and inadequate maintenance practices, a major reason for this contamination is actually a seal design problem. The Civil Aviation Safety Authority of Australia advised the 1999 Australian Senate inquiry into British Aerospace BAe 146 cabin air quality that "all aircraft from time to time suffer fumes within the aircraft. … That is a feature of the basic design of air-conditioning systems in aircraft, being bleed air from engines." British Aerospace advised then that BAe 146 seals may be less efficient during transient engine operations or during warm-up to operating temperatures, and that improvements in seal design were under way and would increase efficiency.

Many state that when the aircraft is functioning properly, there should be no problem with air quality. However, any time air quality causes irritation and discomfort, this is typically a breach of civil aviation regulations. The



majority of cabin air quality monitoring studies have been undertaken during normal flight operations, and their results cannot be applied to oil/fluid fumes events. While many past cabin air monitoring reports have stated that all contaminant levels found were below government-set standards for occupational exposures, these "standards" in fact do not exist because occupational hygiene values applied on the ground should not be applied at altitude. A further concern is that most of these studies used inappropriate methods and monitored for gases and vapors, rather than mists and particulates, and therefore significantly underestimated the exposure effects.[4]

The 1999 Braathens Malmö Aviation BAe 146 incident in Sweden is a prime example whereby there was a known oil leak and in which more than 90 contaminants, including TCP, were identified in subsequent tests. The crew were severely incapacitated, yet the Swedish Accident Investigation Board (SHK) report stated that all contaminants were below government and industry standards. Further, this and other reports failed to look at the potential additive and synergistic effects of such exposures.

More recently, 85 percent of samples from swabs wiped against surfaces in aircraft cabins — on three continents and a range of aircraft types — came back from laboratory analysis positive for TCP. Further, TCP has been found on pilots' trousers and in their blood following in-flight exposure to contaminated air. Current cabin air monitoring by the FAA-funded Occupational Health Research Consortium in Aviation (OHRCA)[5] and research undertaken for the U.K. Department for Transport both have detected TCP in cabin air.

Both short-term and long-term health effects are being reported by aircrew as well as passengers, and this is well documented. Various reports show that TCP has been detected in cockpits and cabins through studies undertaken by numerous organizations including Honeywell, the RAAF, airlines and the CAA. The RAAF recently suggested that the term "aerotoxic syndrome" become internationally recognized to represent a cluster of neurological, neuropsychological, respiratory, immune, gastrointestinal, chemical sensitivity and irritant effects, among others.

Long-term neurotoxicity has been reported, and blood serum tests for neuronal and glial cell autoantibodies — signs of neurological autoimmune disorders — have indicated neuronal cell death in pilots tested. Research also has shown that the additive in jet engine oils can under-regulate and over-regulate gene expression.[6]

As it does not use bleed air, the Boeing 787's design concept appears to be a future solution. However, ECSs using bleed air are going to be in operation for many years, and available evidence clearly shows that a precautionary approach must be taken now, including bleed air filters on all current aircraft to protect crews and passengers. Additional solutions could be implemented, such as installing contaminant-detection systems, selecting less toxic oils/fluids and conducting appropriate epidemiological studies.

The *Aviation Contaminated Air Reference Manual* compiled, edited and published by the author in 2007, provides most of the documentation for this article and covers issues that require attention.[7] The head of research at the RAAF Institute of Aviation Medicine called the manual a "ground-breaking and seminal work" and noted that there has been a "widespread prevalence of denial of the existence of the problem, particularly among the aircraft operators and aviation regulators." ●

Susan Michaelis is the head of research for the Global Contaminated Air Quality Executive <www.gcaqe.org>. A former BAe 146 airline pilot, she is completing a Ph.D. degree at the University of New South Wales, Australia, with a dissertation on aircraft contaminated air.

Notes

1. FAA. "Guidance for Smoke/Fumes in the Cockpit/Cabin." *Flight Standards Information Bulletin for Airworthiness (FSAW)* no. FSAW 06-05A. Amended May 19, 2006.
2. Winder, Chris. "Chemistry and Toxicology of Mobil Jet Oil II." Presentation to the Australian and International Pilots Association, November 2007.
3. Montgomery, Mark R.; Wier, G. Thomas; Zieve, Franklin J.; Anders, M.W. "Human Intoxication Following Inhalation Exposure to Synthetic Jet Lubricating Oil." *Clinical Toxicology.* Volume 11 (November 1977): 423–426.
4. Winder. "Air Monitoring Studies for Aircraft Cabin Contamination." *Current Topics in Toxicology.* Volume 3 (2006): 33–48.
5. The Web site is <www.ohrca.org>.
6. Furlong, Clement E. "Biomarkers of Exposure to TCP." Presentation to the *Flight International* Crew Management Conference, Brussels, Belgium, October 2007. The U.S. National Cancer Institute defines gene expression as "the process by which a gene gets turned on in a cell to make [ribonucleic acid] and proteins."
7. The Web site is <www.susanmichaelis.com>.

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.

Opening new doors by mining aviation data linked to operating trends, a new FAA-industry program delves into safety vulnerabilities.

Preventive Fusion

BY WAYNE ROSENKRANS

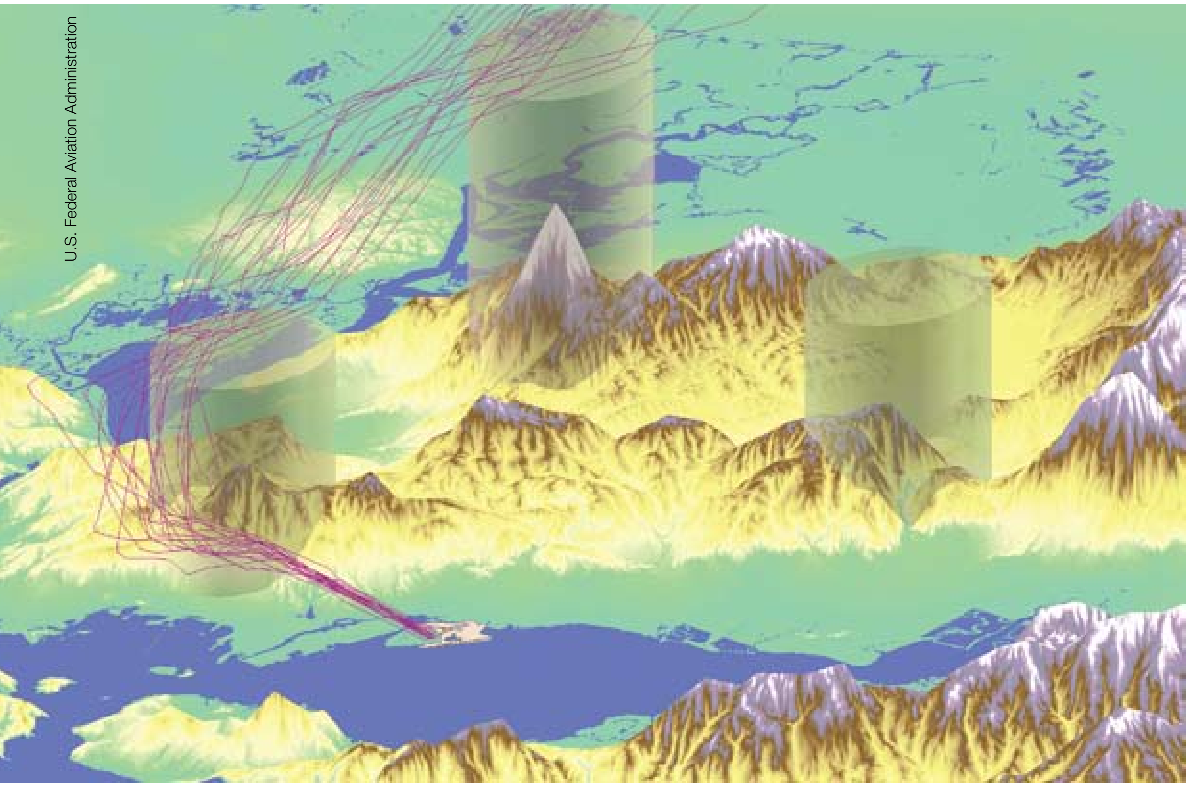
Twenty U.S. airlines routinely analyze parameters of airplane operation captured by their flight operational quality assurance (FOQA) programs. Sixty-one have processes to rectify safety deficiencies identified by narrative reports submitted by pilots through aviation safety action programs (ASAPs).[1] These airlines for years have had measurable safety improvements, but none has had — until 2008 — a robust way to compare its safety performance indicators with industry benchmarks or with broader trends identified through the new Aviation Safety Information Analysis and Sharing (ASIAS) program, a collaborative effort of the U.S. Federal Aviation Administration (FAA) and private-sector partners.

The FAA and airlines now have the capability to cross-query de-identified aggregate data distributed across private network servers and corresponding data on government servers. ASIAS analysts then make sense from results of this fusion of numerical data and narrative-text records. This nascent capability is expected to enhance the safety intelligence that airlines have gained individually with FOQA and ASAP, both voluntary safety programs (*ASW,* 2/08, p. 34-39).

FOQA data typically are shared with the FAA during quarterly briefings of personnel from the agency's certificate management offices or flight standards district offices, covering trend analysis and corrective action plans without physical exchange of data, and during twice-a-year FAA meetings known as FOQA/ASAP Infoshare. ASAP reports from pilots, with some exceptions, typically are handled monthly by event review committees that include an FAA inspector, then are archived in a secure airline database and at the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS).

Each participating air carrier has primary responsibility for identifying

U.S. Federal Aviation Administration



The FAA and industry partners generate computer graphics, like this simulation, to combine radar tracks of flight arrivals, terrain maps and minimum vectoring altitude sectors.

threats and errors, taking corrective action and monitoring program effectiveness. Less well known, however, are details of how the FAA benefits from FOQA, ASAP and the other voluntary programs.

By the end of 2006, the FAA, NASA, government contractors and data-analysis companies had made headway with several proof-of-concept demonstrations, all to enable safety analysis by the FAA and industry at the national level. A high-level architecture for timely awareness of problems had been a key missing element, according to Jay Pardee, director, FAA Office of Aviation Safety Analytical Services, and Michael Basehore, Ph.D., FAA ASIAS program manager. Some prior efforts — such as Voluntary Aviation Safety Information-Sharing (VASIS) and the U.S. Commercial Aviation Safety Team (CAST), which both laid the groundwork for launching ASIAS in October 2007 — had grappled with the challenges of managing extremely large volumes of data, they said.

Multiple Breakthroughs

Among factors that make ASIAS possible are recent advances in the suitability of text-mining tools in commercial off-the-shelf software and the long-sought capability to link weather conditions and/or air traffic control (ATC) environment to aggregated flights without compromising airline or pilot anonymity. The FAA assigned the Center for Advanced Aviation System Development at the MITRE Corp., its federally funded research and development center, to develop the high-level architecture and to synthesize new databases from a secure networked repository of remote databases.

"The primary responsibility for safety is still at the air carrier level, but the FAA has a responsibility to advance a coalition for information sharing beyond the capability of any single carrier, tapping into the industry's vast operational and technical expertise," Pardee said. "The accident at Lexington [Kentucky, U.S.; a Comair Bombardier CRJ100ER in August 2006] exhibited and emphasized the very low frequency of some threats … and the inability to detect them. This was the first fatal accident on a wrong-runway departure in 20 years [*ASW,* 11/07, p. 38–43]. When we went back to incident data during our subsequent wrong-runway departure case study — knowing what we were looking for — the significant disappointment to us was that there were 116 prior events, yet we did not see the Lexington accident coming. We identified 22 contributing factors and nine airport geometries that contributed to wrong-runway departures. Probably no single carrier's database would have revealed more than one event, if any. It was such a rare case."

The FAA considered this case study a breakthrough in narrative text mining. "We were able to look at 5.4 million records — most in the ASRS, the U.S. National Transportation Safety Board Accident Database and the FAA Accident/Incident Data System — in 10 days," Pardee said. "That would not have been possible six to eight months earlier."

The urgency of analysis at the national level also has been driven by the forecasted near-tripling of the number of U.S. airline flight operations by 2025. "From a safety perspective, that means that we need to reduce the accident rate by an equivalent order of magnitude," Pardee said. "We are no longer looking only at repetitive/recurrent threats like controlled flight into terrain, loss of control or approach and landing accidents (*ASW,* 7/06, p. 26–39). Cross-querying databases did not exist at the refined level we have needed; we need to do it now automatically 24 hours a day, seven days a week."

Part of the task of ASIAS is developing safety vulnerability–discovery applications of text–mining tools and tools that manually or automatically can find trends, atypical events, exceedances and aberrations. "We want to transfer technologies and key data sources into the FAA's national distributed data archive," Pardee said. "We want to cast our net around as many databases as possible — including service difficulty reports and international sources such as the European Coordination Centre for Accident and Incident Reporting Systems — leveraging them to get the earliest indication of something to which we can draw the attention of the subject matter experts working for ASIAS."

Automated tools being developed at MITRE and elsewhere eventually will enable ASIAS to monitor databases. "We need to know the important emerging safety threats as they are occurring, or as early as we could possibly detect them," Pardee said. "Automated tools will flag any of the criteria that we direct them to flag. We expect to have the ability to cross-query for the presence of problems we think we already have mitigated through 70 CAST safety enhancements to make sure that, in fact, they have been declining in frequency, and they have not been exacerbated by changes to the National Airspace System or increases in the number of operations."

Trends to monitor include the number of stabilized approaches at various points in the approach; circumstances of minimum fuel/emergency fuel declarations; and systemic factors involved in runway incursions, he said.

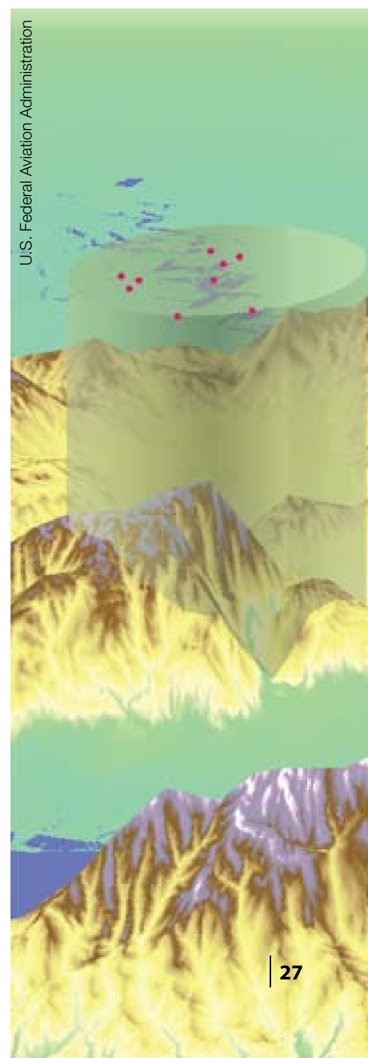
Directed by the government-industry ASIAS Executive Board, the ASIAS program focuses on known-risk monitoring, vulnerability discovery and directed studies.[2] The board determines priorities and where to send investigation results and analyses for follow-up action. As of April 2008, ASIAS had access to de-identified FOQA and ASAP data from seven airlines that operate under U.S. Federal Aviation Regulations Part 121; MITRE's national airspace data related to flight operations, weather, radar and air traffic; and the FAA's data on safety and air traffic trends. "Aircraft manufacturers are likely to be added in May 2008 and maintenance and repair organizations probably will follow within a few months," Pardee said. "ASIAS is in its stand-up phase and to a certain extent beginning to deliver safety products. The primary role of NASA has shifted to development work on vulnerability-discovery tools for ASIAS."

TAWS Alert Example

The ASIAS Executive Board can order a directed study, either on its own initiative or when an issue comes to its attention. In December 2007, the ASIAS Issue Analysis Team, the board's analytical arm, got the green light for its first directed study. Building upon the VASIS process and nearing completion as of April 2008, the study has been examining unexplained terrain awareness and warning system (TAWS) alerts at several mountainous-terrain airports in the United States. Any pattern of TAWS alerts is a red flag to the FAA because of the risk that pilots could become complacent about immediately conducting the escape maneuver. "That is a negative reinforcement of a safety warning system," Pardee said.

FOQA data had provided the first awareness of clusters of TAWS alerts, which are designed to prevent collisions with obstacles or terrain. Alerts can be triggered when, as ATC provides tactical

Simulated FOQA data, overlaid as magenta points, show where TAWS alerts occurred near a minimum vectoring altitude used by ATC above a mountain ridge.



U.S. Federal Aviation Administration

Fusion of FOQA data with air traffic data enables ASIAS analysts to investigate trends in airplane flap speed exceedances and late gear extensions.

radar vectoring, the aircraft has an excessive rate of closure with — or reaches a predetermined distance from — a hazard identified in the TAWS terrain database. Assignment by ATC of the minimum vectoring altitude (MVA) for an ATC sector, a predetermined altitude based only on a required 1,000 ft or 2,000 ft of obstruction clearance, complicates scenarios when the MVA is lower than the minimum sector altitude that the crew sees on paper charts or electronic charts.

"From FOQA data, we have known the event locations," Pardee said. "We have known the height above the ground from NASA space shuttle terrain database mapping and U.S. Geological Survey data. We have known the arrival procedures for the various ATC sectors at the airport … from FAA Standard Terminal Automation Replacement System radar data for arrivals, including the MVA portion of it. We have known which MVA areas were involved. Using FOQA data and FAA National Offload Program data — ATC radar traces — we have been able to correlate the locations where TAWS alerts have been triggered, and by overlaying the approach paths on one particular MVA area of interest, we saw what the typical flight arrival procedures were for a day selected at random."

© Chris Sorensen Photography

Instrument meteorological conditions also have been suspected as a factor in how descents below MVA occurred. "Given the charted arrival and ATC vectoring procedures for arrivals from the east at one airport of interest due to weather, and actual weather at the time, we could see from radar traces airplanes penetrating one MVA on at least six arrivals for a particular date," Pardee said. "We have known from FOQA events at those latitude/longitude coordinates how to filter by this arrival flight pattern all the flight arrival data for any MVA penetrations. This showed that these, in fact, were the arrival tracks that actually produced TAWS alerts."

The reasons are still being sorted out, but ASIAS analysts so far have revealed several things. "For example, ATC instructed crews to make some very sharp turns to the airport and in arrival procedures, ATC set up some flights with difficult maneuvers required to round out the descent and not penetrate the MVA," he said. "ATC also gave some of the flights studied a high descent rate."

ASIAS also has been used to address concerns about the accuracy of specific terrain databases. "We see potential areas for improvement, such as to upgrade the algorithms in the TAWS box [equipment], to reconfigure the MVAs used by ATC for compatibility with the arrival flow from an ATC perspective," Pardee said. "Certain flight profiles lend themselves to TAWS alerts, and aggressive flight profiles during vectoring may make it more difficult for flight crews to avoid penetrating an MVA.

"We also think it makes a difference which version of TAWS software is installed, although none have MVAs embedded in terrain data. Later versions of TAWS software are more attuned to rising terrain and high descent rates. There also needs to be fine-tuning of MVAs and fine-tuning of arrival flight tracks. We need to make sure that all of these system pieces interact properly."

Investigation Without an Accident

Because of its fusion of databases and extensive use of subject matter experts, ASIAS research likely will begin to resemble the accident investigation process — *without* the accident, Basehore said. "We pull in the folks who are familiar with the avionics design, the mechanical design of the aircraft and its capabilities, as well as what ATC and pilots were doing at the time," he said.

During the first fiscal year of ASIAS, the FAA is keeping its scope of investigation narrow and trying to set realistic expectations internally and externally, emphasizing what can be done without major new expenditures by the government or air carriers, Basehore said. "That was an eye-opener to the industry," he said. "We want to demonstrate what we can do with tools that already exist and databases that are already out there." Pardee added, "We have taken on four critical problems, two directed studies, three airline benchmarks and four CAST safety enhancement indicators. We will document how they are done so they can be automated."

Striving for Harmony

To accomplish the ASIAS program's mission, the FAA has had to address not only the technical issues but building relationships of trust, implementing governance and policies that maintain the legal protection of data for safety purposes, convincing airlines and others of the value of participation and dispersing some of the investigative responsibilities among many non-FAA specialists.

From inside the FAA, ASIAS also leverages the expertise of the Air Traffic Organization and its resources, such as terminal radar control radar-track arrivals data, National Offload Program en route data, airport geometry data, Airport Surface Detection Equipment Model X data from more than a dozen airports and ATC national flow data.

"Some of these databases are sensitive and protected — FOQA, ASAP and the FAA's radar-track data, for example," Pardee said. "An agreement in place with all the contributors cites the basic principle that the information is solely used for the purposes of safety, to drive safety decisions — not punitive actions."

Safeguards against misuse of data provided by airlines and other non-government suppliers include physically keeping source data at the suppliers, using "middleware" for one-way encrypted transmission of de-identified aggregate data only; and externally archiving all ASIAS-generated data at MITRE. For FOQA/ASAP airlines — and programs at counterparts such as the new ASAP for FAA air traffic controllers — a memorandum of understanding between MITRE and each data supplier details how data are de-identified, aggregated and digitally bundled for transmission to MITRE/ASIAS, including the conditions for its use by ASIAS.

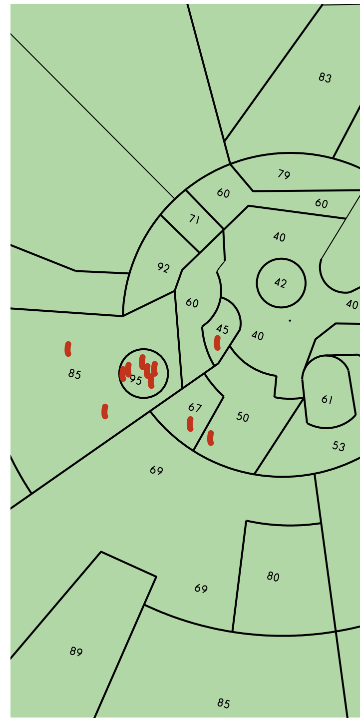
Pardee and Basehore frequently meet with people who bring to the table a history of concerns about any voluntary program for information sharing with the FAA. Pardee said, "We have to say to them, 'This is a new deal, a golden opportunity. We can reconstitute all of the prior information-sharing programs — taking you to a place that you cannot go by yourself.' The suppliers of proprietary, sensitive data have knowledge of how their data is accessed and used. Various members of the ASIAS community are granted authority to generate queries based on the kind and nature of the data they submit. We make them part of the analysis teams because they have knowledge and expertise — and not just so that they can see that proper governance procedures are being followed." ●

For an enhanced version of this story, go to <www.flightsafety.org/asw/may08/asias.html>.

Notes

1. ASAPs also have been implemented for flight attendants, dispatchers and maintenance technicians.
2. The co-chairs of the board are the co-chairs of CAST: Don Gunther, senior director, safety and regulatory compliance, Continental Airlines; and Margaret Gilligan, deputy associate administrator, Aviation Safety, FAA.

U.S. Federal Aviation Administration



Simulated FOQA data, overlaid in red on an illustration of an ATC radar display, show that a sector with a minimum vectoring altitude of 9,500 ft, marked as "95," had the most TAWS alerts on the day studied.

Improving Air Taxi Safety

BY MARK LACAGNINA

Challenges confront efforts to better the charter aircraft accident record.

The safety picture for the U.S. air taxi industry is muddied by the absence of activity-reporting requirements and the diversity of the on-demand operations that are conducted under Federal Aviation Regulations Part 135. There are about 2,800 air taxi operators in the United States with a fleet that ranges from decades-old piston singles to modern large jets. Operations vary from vital bush-flying services in remote areas to long-range international flights. "Pop-up" flights requested by customers with only an hour or two of notice before their desired launch time are the bread and butter of most air taxi operators.

Among the most pressing challenges are growth and a worsening shortage of qualified personnel, especially for international operators. Air taxi operators typically have difficulty retaining experienced pilots and maintenance technicians. Some pilots fly part-time as an avocation; for full-time pilots,

© DayJet

Very light jets such as the Eclipse 500 (above) are entering the air-taxi fleet, joining float-equipped airplanes such as the Turbine Otter and Beaver (left) that have been providing vital air service for years in remote areas.

© Pat Gould/Airliners.net

air taxi typically is a steppingstone to corporate aviation or the airlines.

The most recent detailed data available from the U.S. National Transportation Safety Board (NTSB) on air carrier safety are from 2003.[1] That year, there were 74 air taxi accidents, including 18 fatal accidents and 42 fatalities. Nearly half of the fatalities occurred in four accidents: a Cessna 185 that struck snow-covered terrain in Alaska while transporting mountain climbers to a base camp; and three helicopters that crashed during air-tour flights — an Aerospatiale AS 350BA in Arizona's Grand Canyon and a Bell 206B and a McDonnell Douglas 369D in Hawaii.

In 2003, two accidents occurred in scheduled Part 135, or commuter, operations. A pilot was seriously injured when his Cessna Caravan encountered turbulence in Alaska, and a Cessna 402C was ditched in the Bahamas after an engine failed, resulting in two fatalities.

For the sake of comparison, there were 54 accidents in Part 121 airline operations in 2003, including two fatal accidents with 22 fatalities.

The accident/fatal accident rates per million flight hours were 3.1/0.1 for the airlines, 6.3/3.1 for the commuters and 25.3/6.1 for the air taxis in 2003.

The airline accident rate from 1994 to 2006 remained relatively low and constant (Figure 1, p. 32). The commuter rate increased substantially in 1997 — the year in which the U.S. Federal Aviation Administration (FAA) required all scheduled operations in jet airplanes and other airplanes with 10 or more passenger seats to be conducted under Part 121 — and peaked in 1999 before beginning a general decrease.[2]

The air taxi accident rate decreased substantially from 1994 to 1998, then remained fairly constant, fluctuating between 20 and 25 accidents per million flight hours, before dropping to a record low of 15 accidents per million flight hours in 2006. "Throughout the period, the accident rate for on-demand Part 135 operations … remained almost 10 times greater than the Part 121 rate, reflecting the variety of operating conditions and aircraft found in air taxi, air tour and air medical operations," NTSB said.

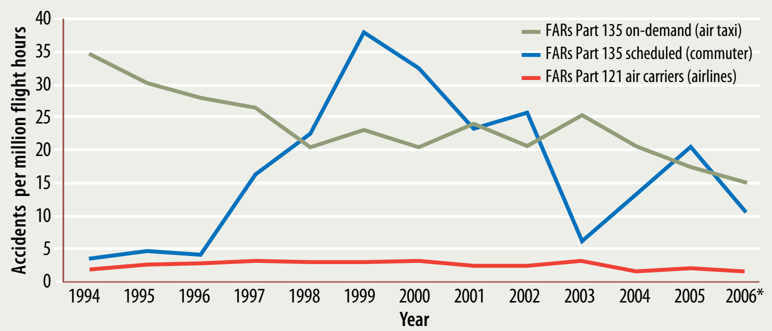
Apples-to-Kumquats

The diversity of air taxi operating conditions and aircraft is one reason a comparison of the air taxi and airline safety records is misleading. Part 121 requires airline operations to be conducted in controlled airspace and at controlled airports that have specific weather, navigational, operational and maintenance facilities. In Part 135, these requirements either do not exist or are less stringent.

Another reason to suspect comparison of the accident-rate numbers is the absence of precise air taxi activity data. Unlike airline and commuter operators, air taxi operators are not required to report their flight hours to the FAA; air taxi activity is estimated from data provided by aircraft owners who participate voluntarily in the FAA's annual *General Aviation and Air Taxi Activity Survey*.

"The small proportion of on-demand Part 135 aircraft surveyed, combined with a sample based on aircraft owners rather than operators and low survey response rates, produces an imprecise activity estimate," said NTSB, which advocates reporting requirements for air taxi operators.

U.S. Air Taxi and Air Carrier Accident Rates, 1994–2006



FARs = U.S. Federal Aviation Regulations

* Data for 2006 are preliminary.

Source: U.S. National Transportation Safety Board

Figure 1

Jacqueline Rosser, executive director of the newly formed Air Charter Safety Foundation (ACSF), says that recent changes to the FAA's survey procedures have resulted in improved activity estimates. "There has been considerable effort at the FAA to identify where those surveys should go and to ensure that every Part 135 operator is being surveyed," she said. "It has been only a year or so since we've had the new process, and we are getting far better data."

The ACSF was formed as an independent entity a year ago by the National Air Transportation Association, which represents U.S. air taxi operators. Among the initial tasks assumed by the new foundation is to derive data on the various air taxi operations. "The denominator, flight hours, for accident rate data is a tricky thing to find when you want to break down the data for jets in passenger service, piston airplanes in cargo service, and so on," Rosser said. "We are committed to improving the data, because it is difficult to target your safety efforts when you don't know what is going on in the industry."

Encouraging Trend

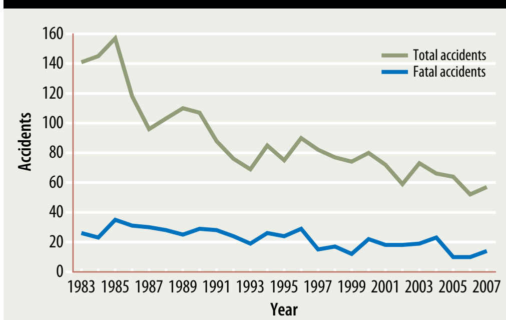
The air taxi safety picture is brought into better focus with data presented by Peter Devaris, manager of the FAA's Safety Analysis Branch, at the ACSF's first Air Charter Safety Symposium in February. Figure 2 shows a generally steady decrease in air taxi accidents over the past 25 years — from a high of 157 accidents in 1985 to 52 in 2006; the total rose slightly last year.

Devaris noted that about 25 percent of the accidents occurred in Alaska, which is the largest and one of the most sparsely populated of the 50 states. With few intercity highways and railways, Alaska is extremely dependent on air transportation; yet, the state has relatively few improved airports, navigational aids and weather-reporting facilities. The terrain is rugged, weather can be extremely harsh, and most air taxi operations are conducted under visual flight rules (VFR) by single pilots in single-engine airplanes.[3] Efforts to improve air taxi safety in Alaska have included the Capstone Program, a joint industry/FAA effort that involved a series of technological initiatives from 1999 to 2006. Capstone has been consolidated with the FAA's nationwide program to implement the ADS-B (automatic dependent surveillance-broadcast) system.

The leading killers in U.S. air taxi operations recently have been accidents involving loss of control in flight, controlled flight into terrain (CFIT), and runway undershoots and overshoots (Figure 3).

Data for the various types of aircraft used in air-taxi operations in 2004 to 2007 (Figure 4) show that, among fixed-wing aircraft, jets had the lowest accident rates: 0.66 accidents and 0.14 fatal accidents per 100,000 flight hours. Piston-engine airplanes had the highest total-accident rates, but

U.S. Air Taxi Accidents, 1983–2007



Source: Air Charter Safety Foundation, U.S. Federal Aviation Administration

Figure 2

their fatal accident rates were lower than the fatal accident rate for twin turboprops.

Rewriting the Regs

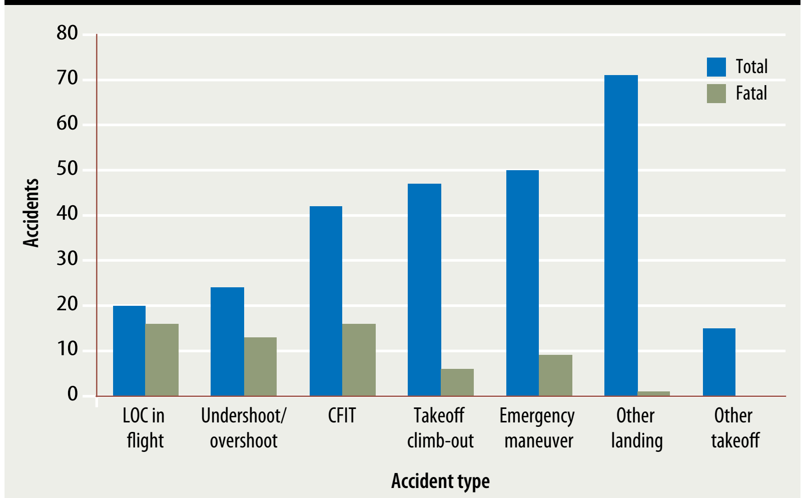
Part 135 was developed and published in the 1960s. The last substantive review of the regulations was performed in 1978; since then, there have been 40 amendments to Part 135. There is concern that the regulations have not kept pace with changes in the Part 135 fleet, which now includes large jets such as the Boeing BBJs as well as very light jets (VLJs) that are being certified for single-pilot operation under the normal category airplane standards of Part 23, rather than the transport category standards of Part 25.

In February 2003, the FAA launched a comprehensive review of both Part 135 and Part 125, which prescribes certification and operating standards for airplanes having 20 or more passenger seats or a payload capacity of 6,000 lb (2,722 kg) or more, and not engaged in "common carriage" — offering air transportation service to the public for compensation.

The Part 135/125 Aviation Rulemaking Committee (ARC) was formed to review the current rules, public comments on the rules, FAA interpretations of the rules and NTSB recommendations generated by accident/incident investigations.[4] More than 80 industry and FAA representatives participated on the ARC steering team and working groups that focused on aeromedical operations, airworthiness and maintenance, applicability, equipment and technology, operations, training, and the anticipated operation of airships under Part 135.

The ARC in late 2005 submitted 167 recommendations to the FAA. Several recommendations were not the result of a consensus of the working group members but were approved by a majority. An example is the ARC's recommendations on flight time and duty time limits, a contentious issue that the FAA has been trying to solve for many years. After receiving more than 2,600 public comments to changes proposed in 1995, the FAA turned to its own Aviation Rulemaking Advisory Committee (ARAC) to sort through the comments; but the ARAC

U.S. Air Taxi Accident Types, 2003–2007

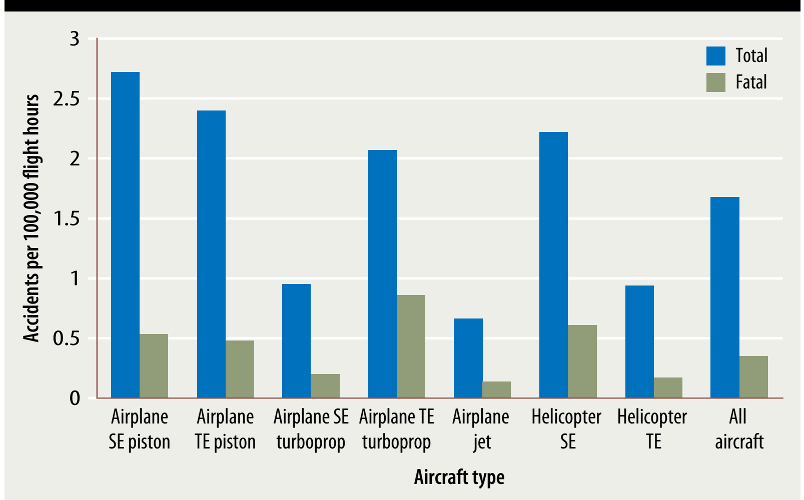


LOC = loss of control; CFIT = controlled flight into terrain

Source: Air Charter Safety Foundation, U.S. Federal Aviation Administration

Figure 3

U.S. Air Taxi Accident Rates by Aircraft Type, 2004–2007



SE = single-engine; TE = twin-engine

Source: Air Charter Safety Foundation, U.S. Federal Aviation Administration

Figure 4

was unable to achieve consensus or gain industry support for the proposals that were generated. Industry groups also tackled the issue, with the same results.

"The difficulty over the years in revising the flight, duty and rest rules is that, in the past, the revision attempts either tried to capture all the fractions of the Part 135 community under one rule, or the revisions attempted to apply scheduled-operation rules to an unscheduled business," the ARC said. Neither approach was acceptable.

The majority proposal generated by the ARC is based on a scheduling scheme called the *crewmember availability method*, which would provide each pilot with a fixed eight-hour "protected period" each day and the operator with a 16-hour "availability" window in which to schedule the pilot's 14-hour duty period. The pilot would have no obligation to the operator during the protected period, but the operator would be allowed to contact the pilot during the last hour of that period. A 10-hour rest period would be required after completion of a flight assignment. The proposal includes limits and associated compensatory rest times for flight assignments that penetrate the protected period.

A dissenting opinion said that the majority proposal would benefit operators more than pilots. "The operators are looking for more availability and 'productivity' from flight crews," it said. "For flight crews, safety advocates and scientists, the question is often not whether to change the current rules but rather how much to reduce the current flight and duty limitations to enhance safety and reduce risk." The dissenting opinion includes detailed recommendations for duty, flight and rest limitations based, in part, on time of day and type of operation.

Helicopter EMS

Several recommendations focused on improving the safety of helicopter emergency medical services (EMS), or aeromedical, operations. A study initiated by the FAA found that in the seven-year period ending in 2004, there were 26 fatal EMS helicopter accidents, including 20 that occurred at night. All five of the fatal accidents that occurred in 2004 involved nighttime CFIT in helicopters that were not certified or equipped for instrument flight rules (IFR) operations and pilots who were not using night vision goggles (NVGs).

The ARC recommended regulatory changes that would allow greater use of NVGs and higher visibility and ceiling minimums for helicopter EMS operations. For example, the committee proposed that the ceiling minimum for local nighttime flights be raised from 500 to 800 ft and that the visibility minimum for helicopters or pilots not certified for IFR operations be raised from 2 to 3 mi (3 to 5 km). The National EMS Pilots Association filed a dissenting opinion, recommending that the minimums for non-IFR nighttime cross-country operations be increased to 1,500 ft and 3 mi and/or 1,000 ft and 5 mi (8 km).

The ARC also considered standards for cabin crewmembers assigned to flights that do not require a flight attendant. The committee recommended separate definitions and standards for *cabin safety crewmembers*, who would have safety responsibilities, and *passenger service specialists*, who would not be allowed to perform safety-related functions and would not be required to receive training. A related recommendation is that the preflight passenger briefing clarify the status and responsibilities of the cabin crewmember when a cabin safety crewmember or passenger service specialist is assigned to the flight.

Among other ARC recommendations are the following:

- Require air-taxi operators to report their flight hours annually.
- Allow commuter operations in jets with fewer than nine seats. No consensus was reached on whether single-pilot operations in VLJs should be allowed.
- Increase the maximum allowable cargo payload from 7,500 lb to 18,000 lb "to provide a means for current [Part] 125 operators who are willing to accept the additional regulatory requirements to transition to [Part] 135 operation." The proposed increase also would make it more economically feasible for Part 135 cargo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When U.S. air-taxi regulations were adopted in the 1960s, operation of large jets with executive accommodations, such as the Boeing BBJ, was not anticipated.

operators to use former regional airliners such as the ATR 42/72, Embraer Brasilia and de Havilland Dash 8.

- Establish *qualification performance standards* — specific training and checking standards — for pilots and cabin safety crewmembers similar to those in Part 121.
- Establish specific criteria for initial and recurrent training of maintenance technicians, as well as a "single flexible maintenance standard that could be tailored to each operator." Current maintenance requirements are different for aircraft that have nine or fewer passenger seats and for aircraft that have 10 or more passenger seats.

Cultural Shift

The ARC recommendations have been grouped into common topics and distributed to the applicable offices at the FAA for review, according to Dennis Pratte, manager of the 135 Air Carrier Operations Branch. Each group of recommendations will go through a separate rule-making process. Pratte's office is reviewing the first group of recommendations — those related to helicopter EMS.

Facilitating instrument operation of EMS helicopters may help reduce the high rate of nighttime CFIT accidents.

"There are a lot of steps in the rule-making process," he said. "We are still in the very early stages, but we are moving forward." Any final action on rewriting Part 135 likely will come several years from now.

Meanwhile, the greatest opportunity for improving air taxi safety involves a cultural shift, said the ACSF's Rosser. "The reasons why we're having accidents are the same as they always have been," she said. "We really do have a phenomenal safety record in this country. What takes us to the next level? We believe it is the SMS [safety management system] philosophy in which the company views not just transportation but *safe* transportation as its product."

Noting the International Civil Aviation Organization's adoption of safety-management standards, Rosser said that development of an SMS is particularly important for air taxi operators that conduct international flights. "It is our goal to help them do that," she said.

In June, the ACSF will introduce a Web-based program that will assist air taxi operators in establishing and maintaining a safety event reporting and management system, which is an integral part of an SMS. "A company's safety culture hinges on employees feeling that they can report their concerns and raise issues in a nonpunitive way," Rosser said. "They also must believe that the events they report will be acted upon."●

Notes

1. NTSB. *Annual Review of Aircraft Accident Data: U.S. Air Carrier Operations, Calendar Year 2003*. NTSB/ARC-07/01, 2007.
2. Before March 1997, commuter operations were allowed in aircraft with 30 or fewer passenger seats and with a maximum payload capacity of 7,500 lb (3,402 kg) or less.
3. Mondor, Colleen. "Among U.S. States, Alaska Has Highest Incidence of Accidents in FARs Part 135 Operations." *Flight Safety Digest* Volume 20 (November–December 2001).
4. The ARC was tasked with determining whether Part 125 should be rescinded. The committee's recommendation was to retain Part 125 with several proposed changes.

'Crash' Course

EASS attendees got an inside look at the world of aviation accident criminalization.

BY RICK DARBY | FROM BUCHAREST

For an industry at risk from the trend toward criminal prosecution following aircraft accidents (*ASW*, 3/08, p. 12), the best defense is safety management systems with ongoing risk analysis and corrective responses, according to members of a discussion panel at the 20th annual Flight Safety Foundation European Aviation Safety Seminar (EASS) and meeting of the European Regions Airline Association in Bucharest, Romania, March 10–12.

Panelists included Simon Foreman, Soulez Larivière & Associés, Paris; Gerard Forlin, barrister, Gray's Inn Square, London; Sean Gates, solicitor, Gates and Partners, London; Robert MacIntosh, chief advisor, international affairs, U.S. National Transportation Safety Board (NTSB); Capt. Andreas Mateou, head of flight safety, Cyprus Airways; Daniel Soulez Larivière, Soulez Larivière & Associés; and Roderick van Dam, head of legal services, Eurocontrol.

Kenneth P. Quinn, FSF general counsel and a partner at Pillsbury Winthrop Shaw Pittman, as moderator opened the discussion, saying, "Pilots, controllers, engineers, boards of directors, managers, regulators — lots of folks are in the cross-hairs these days. Some of you [in the audience] may not know it, but you can be."

A hypothetical accident for which Quinn supplied the "facts," including victims, crewmembers, operators and manufacturers of different nationalities as well as multi-national involvement in the investigation, showed how blame — legal or otherwise — and criminal jurisdiction — if any — can be ambiguous. The evidence in the scenario suggested that several parties had made errors. But were they unintentional and excusable? Reckless behavior? Criminal negligence?

"We have not seen a strong move toward criminal prosecutions in the United States based on the facts of accident investigations," MacIntosh said. "Litigants prefer to pursue civil suits and monetary compensation."

Soulez Larivière works within a legal system that is very different from the Anglo-American one. "There are 10 French citizens involved [in the imaginary accident]," he said. "You have immediately a criminal investigation with an investigating judge in charge. Any accident is a criminal case in France."

Gates, who as legal counsel specializes in aerospace insurance, civil liability and disaster management, said he would defer to Forlin on the criminal aspects of the accident, but added, "The U.K. prosecutors would be investigating, but probably a little slower out of the box."

Referring to a law effective April 6, 2008, in the United Kingdom, Forlin said, "If you ask me now, I would say they would be slower out of the box. In four or five weeks' time, they'll be out of

Criminalization and safety discussion panelists: Sean Gates, Gates and Partners; Daniel Soulez Larivière, Soulez Larivière & Associés; and Simon Foreman, Soulez Larivière & Associés.

Criminalization and safety discussion panelists: Andreas Mateou, Cyprus Airways; Roderick van Dam, Eurocontrol; Robert MacIntosh, U.S. National Transportation Safety Board; and Gerard Forlin, Gray's Inn Square.

All photos: Rick Darby

the box faster than gazelles. The main reason is that, because of a littering of carcasses of failed major corporation manslaughter cases in the last 15 years, the prosecution have now got their way. One reason they failed in the past is that they had to find a controlling or directing mind in the aviation organization, airline or manufacturer who himself or herself was guilty of manslaughter — impossible.

"[Under the new law] the prosecution will only have to show that there's been senior management failure falling far below what's reasonably expected. The danger to the organizations is this: For the first time in law, [prosecutors] will be able to look at the corporate culture, including previous convictions, and also they'll see how far they fell short of any approved codes of practice, any market norms, any industry norms, any health and safety laws, etc."

Flight crewmembers involved in accidents have sometimes had their passports taken away or even been jailed pending the outcome of criminal investigations. Foreman, asked about crewmembers' right to remain silent, said that in France there is such a right, but that the authorities are under no compulsion to inform them of it. "They put a lot of pressure on you, tell you that if you don't talk, it will go against you, your colleague has already spoken," he said. "It's a really tough game. Perhaps in training crews, they should be informed what can happen and that they have a right not to talk."

Van Dam said, "We don't think a controller could reasonably refuse to answer questions. We would strongly guide them, and we would make sure that they would hire excellent counsel or do it for them ourselves."

Prosecutors increasingly try to "flip" a pilot or controller by promising immunity in exchange for testimony against the head of the flight department, head of quality assurance or corporate officers, Forlin said. "Fifteen years ago, it was completely the other way around. Now, the police mindset is very much that other than cases of gross deviancy, these people are actually the victims of the crime, and this is board and management responsibility. So the police now look at the front line operator as the main prosecution witness, a way of going up the command chain."

Among the most controversial issues is to what extent flight data obtained through flight data management or flight operational quality assurance programs must be disclosed for criminal prosecutions. Unlike most civil aviation regulations, criminal procedures differ among European states. "In a criminal case [in France], the investigating judge has all the power; he can take any documents he wants," Foreman said. "The families [of the victims] have status within the criminal proceedings. They are a party to the proceedings. They have a statutory right to ask the investigating judge to go after the documents."

MacIntosh said, "The NTSB strikes a 'delicate balance,' to pursue a thorough technical investigation and at the same time to provide factual information to the public through the media and to the victims and families through family assistance programs. It's also important that we allow other agencies such as those for justice, environment and customs to proceed with their investigative responsibilities under applicable law."

Mateou said, "There is a European directive that all airlines must have an occurrence reporting system. That is part of the SMS [safety management system]. If you don't take the appropriate action [in response to internal reports], if you don't do a proper risk assessment, if you don't have an effective, well-practiced emergency response plan, from now on that can be part of a criminal case."

The discussion was concluded with panelists' thoughts about avoiding, or at least minimizing, the risk of liability.

"If you've done proper risk assessment [before the accident], you might stop the prosecutors from coming after you, and even if they do and you have

Differentiating Aviation Safety Education

AeroSafety World talked with Dennis O'Leary, manager, communications and marketing, Civil Aviation Safety Authority (CASA), Australia, who spoke at the European Aviation Safety Seminar about "A New Look for Australia's Approach to Aviation Safety Education."

ASW: How would you characterize traditional aviation safety education?

O'Leary: Traditionally, bland, lengthy education materials with limited design interest have been made available. Their existence is then not effectively promoted. The audience almost needs to know they're available, and once the materials are obtained, they're not easily consumed, not surprisingly.

ASW: When did CASA undergo a conversion?

O'Leary: I came into the organization in 2006, and we started to change the approach from then. We took a marketing approach to aviation safety promotion.

ASW: What was that?

O'Leary: Two crucial first steps. One, collecting demographic information to understand our audience, their age profiles, their locations, all that sort of stuff. Having identified the audience, the next step was to undertake social research employing qualitative and quantitative techniques with a large sample, to understand how they see safety as an issue. How important is it to them versus other key issues? The expected first answer is, "It's very important, the most significant thing I do." If you push further, you might find them saying something else, "Well, economic factors can come in, etc." We also looked at the issues they believed should be addressed. We explored their views on our current communication tools and how they would prefer to be communicated with in terms of message tone and style and the communication media used. We then reshaped our communication strategies and materials in line with the research findings.

ASW: Did you come up with basic demographic categories for your audience?

O'Leary: We took the age profile or generational cohort approach — the baby boomers, generation X, generation Y. We know, and we also researched this further, that different generations like their information delivered in different ways.

ASW: How do you define boomers, X and Y? What are their respective preferences?

O'Leary: People cross categories, as in anything. But to generalize, baby boomers are aged 45 and up. They tend to prefer face-to-face communication, so they like workshops, seminars and conferences.

Generation X is aged from about 25 or 30 to about 45, they're computer-savvy, they're the "me" generation so they like information targeted at them, and they want it available when they want it. They prefer it in short, easily consumed chunks. They like images, and expect things to get right to the point.

Generation Y, aged 15 to around 25 to 30, is the most technologically literate, although generation X is as well. Generation Y tends to communicate via e-mail, blogs, podcasts. They're used to an advertising-marketing environment, they like their information *very* sharp, *very* pointed. Interestingly, generation Y doesn't even much care for PowerPoint, a so-called essential communication tool for many people.

ASW: So generation Y is used to bite-sized information, blogs, text messages, all that. But isn't a lot of aviation safety information highly complex? How far can you boil it down?

O'Leary: Fair point. I think anything can be distilled to its essence. What you have to do is restructure the way the information is presented. Of course, you can encounter something that's technically complex. But you don't have to get to it in a wordy, convoluted and tiresome way. You can cut straight to the essence of it and importantly provide links or references to other information that expands on the matter.

ASW: Have you measured the results of the new style?

O'Leary: We've set a benchmark on people's attitudes, awareness and reported behaviors. We will go back and measure against those benchmarks.

ASW: So you'll measure actual absorption of information, not just whether the recipients like the format?

O'Leary: Yes. If people say they like the format, that's all very good, but has it been effective? So we're going to go back in a year or more to see how that's gone. That's the reason for the benchmarks. We'll look at awareness on a whole range of aviation safety issues, attitudes on particular issues and reported behaviors.

— RD

to plead guilty on a minor basis, the fact that you've done a root-and-branch internal audit is massive mitigation before a sentencing judge," said Forlin.

Gates said, "You have to have a safety culture embedded in the organization, have that culture supported by the chief executive, have a safety management system that you practice, and do all that you can to operate safely."

"Safety managers must do everything in their power to advise the board in order that the board can take the necessary action," Mateou said. "You should be able to show that you are actively managing safety all the time, minimizing the risks and performing the proper [internal] investigations." ●

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FROZEN FLIGHT INSTRUMENTS

Protection of pitot-static systems often is neglected.

BY BART J. CROTTY

An alarming number of aircraft operators do not have — or do not ensure compliance with — written policies on the use and care of protective covers for aircraft pitot probes and static ports, on-site safety audits over the past three years have discovered.

Contamination of pitot-static systems by foreign object debris (FOD) is a safety hazard to critical flight instruments in aircraft ranging from Piper Cubs to Airbus A380s. A basic safety practice that pilots and maintenance technicians are taught early in their primary training is to protect aircraft flight instruments from blockage or the intrusion of any foreign material. The easiest way is to secure protective covers over the pitot probe(s) and static ports, which allow necessary impact air pressure and ambient pressure, respectively, to enter the pitot-static system. A few manufacturers provide hard plastic plugs that can be inserted into the probes to protect the system. Many large aircraft have flush covers that can be placed over the static ports on the front of the fuselage to prevent insects or airborne debris from entering the system. Brightly colored streamers usually are attached to the covers/plugs to remind personnel to remove them before flight.

Henri Pitot in the mid-1700s established the scientific principles of measuring fluid flow pressure that later were applied to aircraft, to provide pilots with airspeed indications. Both dynamic air pressure and static pressure are used to derive the measurement so critical to flight control. Over time, other flight instruments were connected to the basic indicated airspeed system, and pitot-heating systems were incorporated to prevent the formation of ice that could block or reduce the airflow to various flight instruments.[1]

Many aircraft accidents and incidents have involved pitot-static systems that were affected adversely by ice or FOD that accumulated either during flight or while the aircraft was parked or stored on the ground, or by tape that had been affixed for washing or painting and subsequently forgotten (see "Enterprising Insects").

Zero Tolerance

Modern pitot-static and air data systems are designed with features intended to trap small amounts of moisture, dirt and other substances.[2] However, there is no actual standard for flight instrument tolerance to any water or FOD — in other words, there is *zero tolerance*.[3]

And, although periodic tests of static pressure systems, altimeters and altitude-reporting systems are required, there is no requirement for testing airspeed indicators.[4]

Some aircraft in commercial use have only one pilot station and only one altimeter and airspeed indicator. On large or transport category aircraft, the pitot-static system is part of the air data system. Modern transport category aircraft typically have two sources of pitot and static pressure, and dual flight instruments, which should reduce the impact on flight safety if one of the pitot-static systems should become contaminated or blocked. But experience shows that primary and alternate static systems can — and do — become completely clogged.

The pitot cover on this Learjet has a strap to secure the angle-of-attack vane; the circular static port, however, is not protected.

Most operators have maintenance programs that call for the overhaul of certain flight instruments — but usually after the instruments have accumulated 10,000 hours or more of service since new or since their last overhaul. Some operators maintain flight instruments under an "on-condition" or "reliability" program, which generally means that the instruments continue in service until they fail or until excessive failure or replacement rates are documented. A complete aircraft system test and calibration check usually is not a scheduled maintenance task.

Policies on the use of protective covers on aircraft pitot-static system probes and ports should be developed, recognizing the fact that the airspeed indicator and rate-of-climb instruments — and the air plumbing to these instruments — are not inspected or tested on a scheduled basis.

Gaps in Protection

Recent safety audits of 25 charter operators and airlines worldwide have revealed the following problems in protecting pitot-static and air data systems:

- No written policies;
- Vague written or verbal policies;
- Different applications of verbal policies among pilots, mechanics and ground personnel;
- No standard location in aircraft for storing pitot probe and static port covers;
- Storage locations that are not convenient to user access;
- Pitot cover linings that are torn or frayed, burned or charred (from installation on hot probes), or contain dirt or loose plastic;
- No requirements or standards for periodic examination of pitot cover linings; and,
- Soiled, inconspicuous or missing warning streamers.

During more than half of the safety audits, multiple discrepancies were found. None of the audits found all the elements of a satisfactory policy for protecting pitot-static and air data systems.

Opinions among aircraft operators differ about the policies and practices that should be followed, based on their experience, location, operating and environmental conditions, fleet makeup, and other factors. Manufacturers' recommendations are not always practical, and civil aviation authorities usually provide only advice and guidance, not specific requirements. The only universal agreement likely

Enterprising Insects

A recent report by the Australian Transport Safety Bureau (ATSB) shows how quickly an unprotected pitot-static system can become contaminated.[1] The incident involved an Airbus A330 that was at the gate at Brisbane Airport's international terminal about 55 minutes before pushback for a flight to Singapore.

While rolling for takeoff, the pilot-in-command (PIC) and the copilot, the pilot flying, noticed that the PIC's airspeed indication was 70 kt while the copilot's airspeed indication was 110 kt. The PIC assumed control and rejected the takeoff. The report said that the PIC's decision to reject the takeoff was "reasonable" and "consistent with the operator's SOPs [standard operating procedures]."

While vacating the runway, the crew noticed that the wheel brake temperatures were increasing. Although the brake-cooling fans were activated, brake temperature continued to increase until the fusible plugs in six of the eight wheels on the main landing gear melted, causing the tires to deflate while the aircraft was being taxied on the ramp. The crew stopped the aircraft and shut down the engines, and the passengers were disembarked with portable stairs.

"A postflight engineering inspection of the aircraft found what appeared to be wasp-related debris in the PIC's pitot probe," the report said.

Noting that there was a "wasp problem" at the international gates, the report said that the March 19, 2006, incident was the fifth involving a "pitot system fault during takeoff" at Brisbane so far that year. All the incidents involved A330s, but none involved the same aircraft. Three takeoffs were rejected; two were continued, and the flight crews "actioned an instrument-switching, non-normal procedure and cleared the fault" on their way to Singapore, the report said.

However, one of the aircraft subsequently was involved in a rejected takeoff at Singapore when the crew observed an "IAS" (indicated airspeed) caution message on their electronic centralized aircraft monitor. "An engineering inspection at Singapore found no foreign matter in the aircraft's pitot system, and the aircraft was returned to service," the report said. "During the subsequent takeoff, the crew again rejected the takeoff as a result of a further airspeed discrepancy. The fault was suspected by the operator's maintenance staff to be the result of a prior pitot probe contamination migrating to the aircraft's air data module."

After the third incident at Brisbane on Feb. 5, the operator's maintenance manager at the airport had instructed line maintenance personnel to "fit pitot probe covers as soon as possible and remove them as close as possible to departure." A survey of the line engineers revealed different interpretations of the instruction. "Some engineers stated that pitot probe covers should be fitted if the aircraft's turn-around time exceeded three hours, whereas other engineers commented that fitment was dependent on the level of wasp activity present that day," the report said. Pitot probe covers had not been installed on the aircraft involved in the March 19 incident.

The report noted that the operator initiated a pest-eradication program that has been successful in controlling wasp activity at Brisbane.

— Mark Lacagnina

Note

1. ATSB report no. 200601453, "Rejected Takeoff, Brisbane Airport, Qld, 19 March 2006, VH-QPB, Airbus A330-303."

is that protection is required during long-term storage and during sand, snow/ice or dust storms.

Whatever the individual operator's experience or operational situation may be, once the hazards of contaminated pitot-static or air data systems are evaluated or re-evaluated, and a policy and standards are adopted or revised, no more than one page of the company manual would be required to establish the protection requirements and provide the first step in eliminating or substantially reducing the problems listed above. ●

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Notes

1. In most aircraft, flight crewmembers must manually activate pitot or air data sensor heating systems. For more than 30 years, the U.S. National Transportation Safety Board has urged the Federal Aviation Administration to require automatic activation of the heating systems (*ASW*, 11/07, p. 10, "Automatic Heat").
2. U.S. Federal Aviation Regulations (FARs) Part 25, *Airworthiness Standards: Transport Category Airplanes*. Part 25.1323, "Airspeed Indicating System." Part 25.1325, "Static Pressure System." Similar design features are required by Part 23 for non-transport-category airplanes and by Parts 27 and 29 for rotorcraft.
3. Telephone interviews with Edward Haering, engineer and air data specialist, U.S. National Aeronautics and Space Administration Dryden Flight Research Center; and Roy Gentry, vice president, Kollsman Commercial Aviation Systems.
4. FARs Part 91, *General Operating and Flight Rules*. Part 91.411, "Altimeter System and Altitude Reporting Equipment Tests and Inspections."

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BY SUSHANT DEB

An SMS Standard

Despite the well-intended efforts of international and national aviation bodies, there is no comprehensive standard for airport safety management systems (AP-SMS). Current safety efforts are not based on a systems approach designed to achieve a condition where risks are managed to an acceptable level.

Since the Sept. 11, 2001, terrorist attacks in the United States, however, airport operational safety has been identified by civil aviation authorities throughout the world as an important concern. Many international bodies and federal agencies have examined the need for an AP-SMS and — independently of each other — have developed implementation proposals.

In November 2005, the International Civil Aviation Organization (ICAO) amended Annex 14, Volume 1, *Airport Design and Operations*, to require member states to have all certified international airports establish an AP-SMS. In March 2006, the Airports Council International (ACI) presented the ICAO Directors General of Civil Aviation (DGCA) Conference with a proposal to introduce a Web-based safety network system for airports.

In February 2007, the U.S. Federal Aviation Administration (FAA) proposed in Advisory

Circular (AC) 150/5200-37 that U.S. airport operators implement an SMS not only to meet ICAO standards but also to complement existing Federal Aviation Regulations Part 139, "Certification of Airports." In April 2007, the *SMS Pilot Study Participant's Guide* was made available by the FAA. In addition, FAA AC 150/5200-18C, *Airport Safety Self-Inspection,* established a checklist primarily for airport operations areas such as ramp/apron aircraft parking areas, taxiways, runways, fueling facilities, buildings and hangars. However, the checklist is not system-based.

ICAO Document 9859, *Safety Management Manual* — first issued in 2006 — was developed to encourage a standardized approach to SMS.

The ICAO definition indicates that an AP-SMS must follow the systems process; that is, it must have a goal, a plan to achieve the goal, processes and procedures developed according to the plan, and an evaluation process to measure the achievement of the goal. An AP-SMS standard must be comprehensive — every activity and/or process related to airport operations must be addressed by the standard.

for AIRPORTS

A new proposal expands on existing requirements for safety management systems.

A Management System Approach

The AP-SMS standard proposed in this article is essentially a management system approach to controlling risk. As a basic principle, most management system models follow the plan-do-check-act (PDCA) cycle of continuous improvement to control safety risks. All individual processes in an airport are planned (P), performed as planned (D), reviewed for effectiveness (C) and modified as necessary (A).

Generally accepted industry standards and the ICAO guidance describe SMS in terms of four distinct elements: safety policy and objectives, safety risk management, safety assurance, and safety promotion. The core SMS model suggested by the FAA advisory circular is based on the same four elements, called "safety pillars." The AP-SMS standard proposed in this article, therefore, has these four pillars as a foundation.

The first pillar, safety policy and objectives, is not just an expression by the organization; it refers to the development of a safety management organization for the airport. According to the FAA advisory circular, the second pillar, safety risk management, refers to airport operations risk management. The airport operator must attempt to optimize the safety performance of its operations through proactive identification of hazards; assessment and measurement of safety risks; implementation of actions to mitigate the hazards and risks to an acceptable level; tracking the mitigation activities to ensure that they are appropriate and effective; and, if required, modification of the mitigation activities.

An emergency response plan should be added as a complementary element of this pillar. After the 2001 terrorist attacks, this makes sense because any emergency — or crisis — response plan is based upon an assessment of risk appropriate to the size and type of operations.

The third pillar, safety assurance, calls for the risk controls developed under the second pillar to become organizational system requirements. The model proposed by the FAA advisory circular includes safety oversight — not to be confused with currently practiced airport self-inspection mentioned earlier. Because airport operations today involve participation of service providers not employed by the

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airport, “outsourcing of controls” is added to safety oversight. This is appropriate in the environments that have existed since Sept. 11, 2001. Safety promotion, the final pillar, is the foundation of a sound safety culture and emphasizes training, communication and participation.

Safety, like quality, requires continuous nurturing. The proposed AP-SMS standard must ensure this iterative concept and reduce risk to a level as low as reasonably practicable. The safety system, like the quality system, goes through a cycle of continuous improvement, from organization to implementation to audits to taking corrective and preventive action. Therefore, the AP-SMS standard could be developed in line with the concept of the ISO 9001:2000 standard, the International Organization for Standardization framework for operating a quality management system. This ISO approach seems appropriate because safety and quality are intertwined.

Safety, like quality, requires continuous nurturing.

The proposed AP-SMS standard describes the requirements for an airport operator’s safety management system. The standard proposed here applies to Part 139 certified airports and general aviation airports in the United States and to airports of equivalent status in the rest of the world. The AP-SMS auditor will determine additional requirements applicable to individual airport operators. The AP-SMS standard would incorporate the minimum acceptable requirements of the FAA and ICAO, cited earlier in this article.

Five Clauses

The proposed AP-SMS standard has five parts — called clauses — including the four main pillars outlined by the FAA. The requirements for specifications to be documented and implemented by an airport operator are inherent in the standard. The fifth clause is safety improvement, which should contain provisions for dealing with self-evaluation of an airport’s existing SMS. This is in line with the check and act parts of the PDCA-principle. Thus, the five clauses are:

- Safety policy and objectives — The emphasis is on the airport operator’s organization and its management system. The clause should address developing an SMS manual, management commitment, periodic management reviews of the SMS, documentation requirements, establishing stakeholders’ responsibilities, establishing safety policy, and establishing safety objectives consistent with the policy.
- Safety risk management — The proposed AP-SMS standard recognizes that airport operation is a business that involves significant risk. While it makes good business sense to reduce risk and avoid the high costs associated with airport incidents and accidents, it would be prohibitively expensive and detrimental to the business environment if an airport operator were to try to eliminate all risks. This clause should address the operator’s existing risk management system, along with its performance measures, as a means of evaluating the effectiveness. The standard would require the operator to define acceptable and unacceptable levels of safety risk, actual safety risk analysis and mitigation strategies.

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- Safety assurance — The proposed standard requires the operator to implement a self-auditing program (SAP) to evaluate how well the organization adheres to safety policy and meets its safety objectives, in addition to the airport operator's existing responsibilities for self-inspection and correction of discrepancies under Part 139 in the United States or equivalent requirements in other countries. The SAP must include each operations area of an airport.
- Safety promotion — This clause addresses safety training and education, safety communication and safety competency. The idea of this part of the proposed standard is to ensure that safety-promotion efforts are visible in all aspects of an airport's operations. This is about developing a safety culture.
- Safety improvement — This clause examines the safety management life cycle. It requires measurement of customer perception, monitoring and measuring SMS performance, implementation of corrective action for each safety non-conformity (SNC) generated during the SAP, determination of actions to eliminate the causes of potential SNC, and safety lessons learned.

The administration of the standard should not be difficult. For Class I and Class II airports under Part 139, all clauses should apply.[1] The audit duration should be at least 80 hours — 40 hours conducted by each of two auditors. For Class III, Class IV and general aviation airports, only the clauses and subclauses selected by the AP-SMS auditor as applicable would be required. The audit duration should not exceed 40 hours by one auditor.

Each airport certified under the standard would undergo a recertification audit every third year and a surveillance audit annually.

An experienced auditor could use one of several methods; however, it is strongly recommended that an audit for accreditation follow guidelines provided by the European Aviation Safety Agency (EASA) in Document Q.1003-00.

An auditor conducting an audit using the AP-SMS standard should be certified as an ISO 9001:2000 lead assessor by the International Register of Certificated Auditors (IRCA) or an equivalent organization, and must be thoroughly familiar with the Part 139 airport certification process or its equivalent and with the current versions of several ICAO documents: Annex 14, Volume 1; ICAO Document 9774, *Certification of Aerodromes*; ICAO Document 9859; and ICAO Annex 17, *Safeguarding International Civil Aviation Against Acts of Unlawful Interference*.

In conclusion, the standard proposed in this article focuses on a combination of systems, policies, programs, processes, plans, procedures, facilities, components, types of equipment, and other safety aspects of airport operations that are considered an operational necessity.

Protecting against unknown airport safety and security hazards is an inexact science, and it is difficult to plan where to start. The fact that the future of airport safety and security will always be an unknown entity further complicates the design, development and packaging

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of an AP-SMS. However, the AP-SMS standard proposed in this article can be applied to commercial and general aviation airports anywhere in the world. ●

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Note

1. FARs Part 139 defines a Class I airport as one certificated to handle scheduled operations of large air carriers, as well as unscheduled passenger operations of large air carriers and/or scheduled operations of smaller aircraft. A Class II airport is certificated for scheduled operations of small air carriers and unscheduled passenger operations of large air carriers. A Class III airport is certificated for scheduled operations of small air carriers, and a Class IV airport is certificated for unscheduled passenger operations of large air carriers.

The NTSB says an operating radio altimeter likely could have prevented the fatal crash of a Eurocopter EC 135P2 on an EMS repositioning flight.

Dark-Night EMS

BY LINDA WERFELMAN

The wreckage of the EMS helicopter was pulled from the Potomac River south of Washington after the January 2005 accident.

© AP Photo/Gerald Herbert

An emergency medical services (EMS) Eurocopter EC 135P2 was being flown in dark night conditions over the Potomac River on a low-altitude positioning flight when it crashed into the water near Oxon Hill, Maryland, U.S. The pilot and flight paramedic were killed, and the flight nurse was seriously injured in the accident, which destroyed the helicopter.

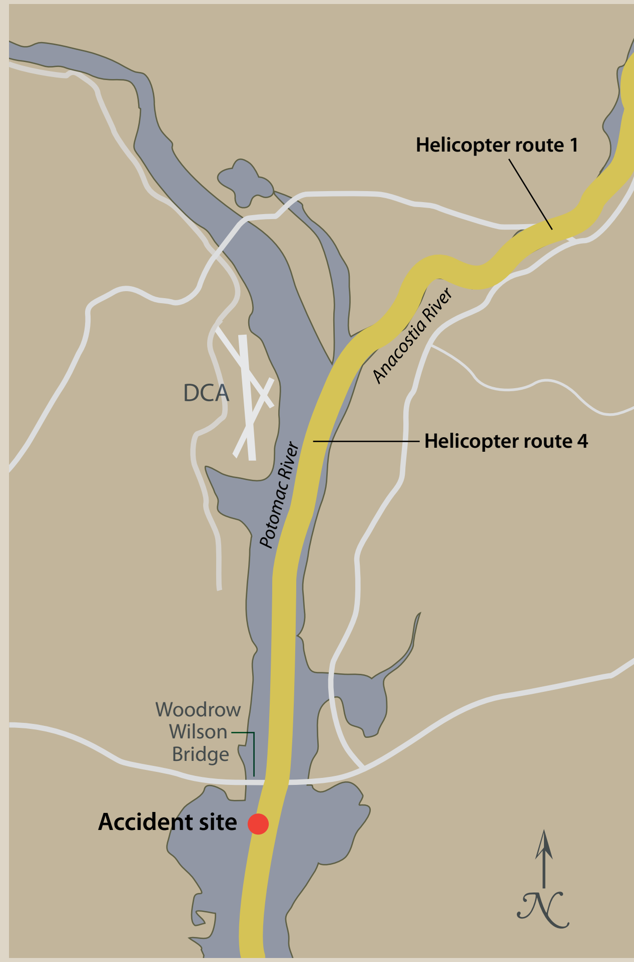
The U.S. National Transportation Safety Board (NTSB) in its final report said that the probable cause of the Jan. 10, 2005, accident was "the pilot's failure to identify and arrest the helicopter's descent, which resulted in controlled flight into terrain." Contributing factors were "the dark-night conditions, limited outside visual references and the lack of an operable radar [radio] altimeter in the helicopter," the NTSB said.

The flight, operated by LifeNet, began about 2304 local time at the Washington Hospital Center Helipad (DC08) in Washington, D.C., with a destination of Stafford Regional Airport, about 40 nm (74 km) southwest. The pilot followed a published helicopter route through Washington to the southwest, toward the intersection with another published route that ran north-south along the Potomac River.

Air traffic control (ATC) radar data showed that the pilot intercepted the second published route and flew the helicopter south along the river toward the Woodrow Wilson Bridge. The helicopter's Mode C transponder — which provided information on the helicopter's altitude above mean sea level in 100-ft increments — indicated that altitude varied from zero to 100 ft but increased to 200 ft when the helicopter was about 0.5 nm (0.9 km) north of the bridge, the report said. The elevation of the Potomac River in the area is about 10 ft.

At 2311:30, when the helicopter was 0.25 nm (0.46 km) north of the bridge at 200 ft, the pilot responded to an ATC traffic advisory, saying that the helicopter would "be out of [the] way" of an Airbus on final approach to Ronald Reagan Washington National Airport (DCA). There were no further radio communications from the helicopter.

The flight nurse, who had been seated in the left front (copilot's seat), said that as the Airbus



Susan Reed

approached, the helicopter pilot "made a change in his flight path and started to descend."

ATC radar data showed that, at 2311:39, the helicopter had crossed the bridge to the south at 200 ft with a ground track of 180 degrees. At 2311:43, the helicopter was at 100 ft with a ground track of 190 degrees. The last recorded position, at 2311:48, showed an altitude of zero and a ground track of 200 degrees. The Airbus was about 2.2 nm (4.1 km) south of the helicopter at 1,700 ft.

NTSB analyses determined that the helicopter's flight path angle was minus 3 degrees and it was banked about 12 degrees right when it struck the water 3.5 seconds after the last radar return. The NTSB also ruled out any possibility that the accident resulted from wake turbulence or a bird strike.

The flight nurse said that the helicopter's master caution lights and panel segment lights did not illuminate and that he heard no audio alarms before the crash. The pilot had not

Eurocopter EC 135

© Andrea Bernardi/Airliners.net

The Eurocopter EC 135 is a light utility helicopter. Its first prototype was flown in 1988 and was known then as a BO 108; the first two production EC 135s were delivered in 1996.

The EC 135P2 was introduced in 2001, with two Pratt & Whitney PW 206B2 engines, each capable of 463 kw (621 shp) at takeoff and 419 kw (562 shp) maximum continuous.

The EC 135 can be configured to carry seven people, including one or two pilots. The accident helicopter was configured with two pilot's seats, an aft-facing passenger seat in the left aft cabin and an area for one medical patient in the aft cabin.

Maximum empty weight is 3,284 lb (1,490 kg), and maximum takeoff weight is 6,250 lb (2,835 kg). Maximum cruise speed is 138 kt, maximum rate of climb at sea level is 1,500 fpm, and service ceiling is 9,600 ft.

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

performed any evasive maneuvers or indicated that there were any difficulties, the flight nurse said. The report said that the flight nurse had told investigators that after the helicopter flew over the southern part of the bridge, his next memory was of "being submerged in water with his seatbelt on and his helmet off." He exited the helicopter and waited in the water near the tail section, where the occupants of a rescue boat found him.

The pilot, 56, was hired in 2004 by LifeNet, a Chesterfield, Missouri, operator with 89 helicopters and airplanes at numerous locations across the United States. He had a commercial pilot certificate with ratings for single- and multi-engine land airplanes, helicopters and instrument helicopters, and a second-class medical certificate. When he applied for his medical certificate in May 2004, the pilot said that he had 1,500 flight hours of civilian experience; he also had 2,400 flight hours in military helicopters, accumulated while he was a pilot in the U.S. Army from 1968–1971.

In his employment application, the pilot said that he had been retired since 1997 but that he was current for operations under U.S. Federal Aviation Regulations Part 135, "Commuter and On-Demand Operations" and had passed Part 135 check rides in a Bell 206 in February 2004 and in a BK-117 in April 2004. From 1971 until 1997, he had worked for a corporation in flight positions and non-flight positions, accumulating 400 flight hours in Agusta 109s and Sikorsky S-76s and 300 flight hours in airplanes.

The resume submitted to LifeNet did not mention his most recent previous employer, another Part 135 helicopter operator for whom the pilot worked for two weeks in April 2004. According to the company's chief pilot, the accident pilot's employment was terminated because he was "unable to adequately perform complex tasks in the helicopter or fly a 'complete mission' involving several tasks in a series," the report said. LifeNet was unaware that the pilot had held the job — and unaware of the termination.

The report said that two medical crewmembers who had flown with the pilot the night before the accident, on the same route as the accident flight, had said that the pilot "flew the helicopter in a manner equivalent to other pilots in the company."

The helicopter, manufactured in 2004, had 167 total hours at the time of the accident. It had been maintained according to an FAA-approved aircraft inspection program, with the last 50-hour inspection program on Dec. 17, 2004, and the last 100-hour inspection on Nov. 23, 2004.

A Jan. 10, 2005, notation in the maintenance logbook indicated that the radio altimeter was inoperative. An entry in the maintenance log's section on "Record of Minimum Equipment List

(MEL) Items and Deferred Maintenance" said that maintenance on the radio altimeter could be deferred until Jan. 20, 2005. Examination of the wreckage revealed no mechanical problems that would have contributed to the crash, the report said.

Dark night visual meteorological conditions prevailed at the time of the accident, the report said. Information recorded at DCA, 3.5 nm (6.5 km) north of the accident site, at 2251 included calm wind, visibility of 10 mi (16 km) and broken clouds at 13,000 ft and 20,000 ft. A new moon, below the horizon, provided no illumination, the report said.

Professional helicopter pilots who frequently fly along the Potomac River near the Wilson Bridge told investigators that the area south of the bridge is very dark, in large part because park and bird habitats in the area limit the extent of lighting on the shoreline.

"Flying at night from north to south over the Woodrow Wilson Bridge is very similar to going into actual instrument conditions," one helicopter pilot said. "A pilot [flying] low-level north of the bridge is typically flying VFR [visual flight rules] due to the intense amount of ground lights available along the river. Once the pilot crosses the bridge, he is now flying into a black void. At this point, an instrument scan must be established to maintain altitude. Because of the close proximity to water … a radar altimeter is necessary to ensure altitude awareness."

The report cited the FAA *Aeronautical Information Manual*'s discussion of illusions in flight, which says that "an absence of ground features, as when landing over water, darkened areas and terrain made featureless by snow, can create the illusion that the aircraft is at a higher altitude than it actually is."[1]

The report said that, because the helicopter was being flown in dark night conditions, references to flight instruments would have been required to help maintain a safe altitude above the river.

"However, about eight seconds before the onset of the helicopter's banking descent, the pilot diverted his attention from the instruments, at least momentarily, because he stated to the controller that he was looking for the approaching Airbus traffic," the report said. "Additionally, the flight nurse stated that, because of the traffic, the pilot 'made a change in his flight path and started to descend.'"

If the pilot had detected an unintentional descent, the report said, "he would have had to respond immediately to arrest it because of the helicopter's cruise speed and low altitude."

A functioning radio altimeter would have provided constant height information and a visual and/or aural alert that the helicopter had descended below a preset altitude, the report said, noting that the radio altimeter had been functioning the night before the accident, when the same pilot flew the same route without difficulty.

In a concurring statement accompanying the final accident report, NTSB Member Kathryn O'Leary Higgins called for a review of pilot hiring practices.

"Could LifeNet have learned more about this pilot before hiring him?" she asked. "If they had known that he had been terminated by another EMS operator after two weeks because he did not meet their standards, would they have offered him a job?"

An existing law — the Pilot Records Improvement Act — requires some operators to request and evaluate information from the previous employers of applicants for piloting jobs. In this case, however, the pilot did not identify his most recent previous employer, the report said.

As a result of the investigation of this accident and a 2004 Bell 206L-1 EMS accident,[2] the NTSB issued two safety recommendations emphasizing the critical role of radio altimeters in EMS operations. The recommendations said that the FAA should require the installation of radio altimeters in all helicopters used in EMS night operations and should ensure that the MELs for these helicopters require that radio altimeters be operable during night operations.

Both accidents "likely could have been prevented if the helicopters' [radio] altimeters were operative and used by the pilots as tools to avoid CFIT [controlled flight into terrain]," the NTSB said. "Because of the complexity of flying in night conditions, [radio] altimeters can provide invaluable and potentially live-saving information to flight crews, particularly when they are flying at low altitudes." ●

This article is based on NTSB Aviation Accident Brief NYC05MA039.

Notes

1. FAA. *Aeronautical Information Manual: Official Guide to Basic Flight Information and ATC Procedures*, Chapter 8-1-5, "Illusions in Flight, Featureless Terrain Illusion." Washington, D.C.: FAA, 2006.
2. The Bell 206L-1 accident occurred during night visual meteorological conditions on April 20, 2004, in Boonville, Indiana, U.S., when the helicopter crashed into up-sloping terrain while transporting a patient from one hospital to another. The patient was killed in the crash and the pilot, paramedic and flight nurse received serious injuries. The NTSB said in its final report that the probable cause of the accident was the pilot's "inadequate planning/decision, which resulted in his failure to maintain terrain clearance." The report cited as contributing factors the pilot's "inadequate preflight planning, his diverted attention and the dark-night conditions." The report said that a pilot who had flown the helicopter before the accident flight had reported that the radio altimeter was operating "erratically."

Supply Chain's Weak Links

Almost all audited suppliers to U.S. aviation manufacturers were found to have deficiencies.

BY RICK DARBY

Among the 21 major aircraft-component suppliers to U.S. manufacturers audited by the Department of Transportation (DOT) inspector general office, some 67 percent had deficiencies in their oversight of sub-tier — subcontracted — parts vendors, and the same percentage had product records/documentation deficiencies. Various other deficiencies were found at between 10 percent and 62 percent of the suppliers. In all, 20 of the 21 did not fully meet requirements.[1]

"Manufacturers are increasingly using domestic and foreign parts and system suppliers to reduce their manufacturing costs and spread risks among multiple partners," the DOT report said. "For example, Boeing's risk-sharing partners in Japan, Italy and the United States will build composite structures for the Boeing 787, which will include sub-systems that are already certified, tested and ready for final assembly."

Figure 1 shows the increasing use of non-U.S. parts on successive Boeing aircraft models. The airframe of the 727, introduced in 1964, was almost entirely U.S.-built. That of the 787, currently in production, will include parts from Australia, France, Italy, Japan and China.

"Since 1998, FAA [the U.S. Federal Aviation Administration] has worked towards implementing a risk-based oversight system for aviation

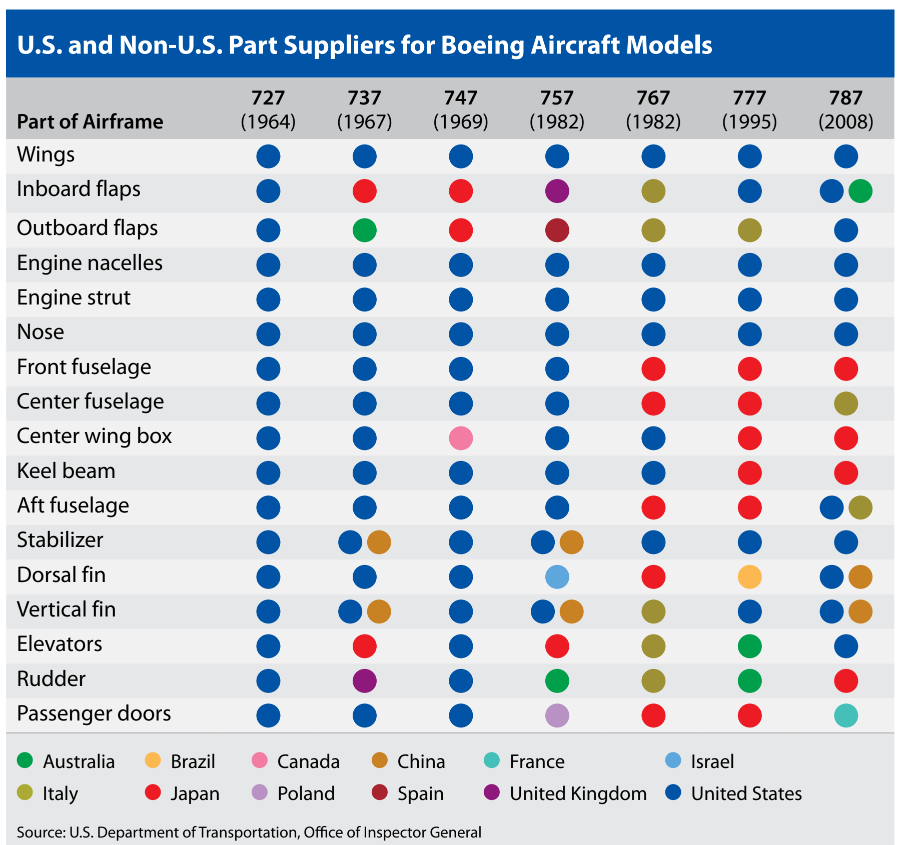


Figure 1

manufacturers," the report said. "However, this system was implemented in fiscal year 2003 and does not take into account the degree to which manufacturers now use suppliers to make aviation products. FAA based the new system on historical manufacturing business models, in which manufacturers maintain primary control over the production of their aircraft rather than use suppliers to design and manufacture extensive portions of aircraft."

FAA inspectors perform risk assessments of each manufacturer, and based on those, the agency decides how many supplier control audits it will conduct to test the manufacturer's quality assurance system, the report said. Supplier control audits are an FAA tool to assess how well aircraft and systems manufacturers' oversight programs are working. But the number of supplier audits is not correlated with the number of suppliers, the report said.

"To illustrate, based on FAA guidance, a manufacturer that has 2,000 suppliers and is assessed as a high risk will require the same number of supplier audits as a high-risk manufacturer that has only 20 suppliers," the report said. "Inspectors are only required to perform, at most, *four* supplier audits regardless of the size of the manufacturer, the number of suppliers used or the criticality of the part produced."

Although manufacturers are required to have an FAA-approved quality control system that makes them responsible for ensuring that their parts are properly produced, three of the five major manufacturers reviewed had not developed requirements to perform regularly scheduled supplier control audits.

Table 1 shows the number of audits of five major manufacturers completed by the FAA in four recent fiscal years. "In each of the last four years, FAA has inspected an average of *1 percent* of the total suppliers used by the five manufacturers we reviewed," the report said. "At FAA's current surveillance rate, it would take inspectors at least 98 years to audit every supplier once."

The DOT inspector general, working with an international air transport consulting firm, audited facilities of 21 suppliers, both U.S. and non-U.S., that make components for Airbus, Boeing, Bombardier Learjet, General Electric Aircraft Engines, Pratt & Whitney and Rolls-Royce. All except Airbus have manufacturing facilities in the United States.[2]

The checklist used to conduct the audits addressed the same areas that FAA inspectors review when conducting supplier control audits. The report said, "Our on-site audits covered the supplier's quality system — from the contracts with the manufacturer to the actual parts production, parts inspections facility and production line safety, and shipping."

Figure 2 (p. 52) shows the percentages of suppliers where various categories of deficiencies were found in the DOT audit. "We identified widespread discrepancies at 20 of the 21 suppliers we reviewed, such as suppliers' inadequate oversight of the part and component suppliers they use (i.e., sub-tier oversight), use of out-of-date tools and equipment, and failure to complete all product testing before shipping parts to the manufacturer," the report said.

Six of the audited facilities had had little or no oversight by the manufacturer during the 24 months preceding the auditors' visit. Five of the six had not received any visits from the FAA during the same period.

"For the two years prior to our review, 14 … did not perform regular, on-site evaluations of their sub-tier suppliers," the report said. "These suppliers relied on mail-in self-evaluations provided by their sub-tier suppliers or relied on an industry standard quality system certification (e.g., ISO 9001) in place of an on-site audit."

The report also called attention to the 43 percent of suppliers that lacked

Number of Supplier Audits Completed by FAA for Five Major U.S. Aircraft Manufacturers

Manufacturer	Number of Supplier Facilities	Supplier Audits Completed by FAA				Average Percent per FY
		FY 2003	FY 2004	FY 2005	FY 2006	
A	4,012	2	1	7	4	1%
B	2,553	31	26	15	27	1%
C	706	5	4	4	6	1%
D	489	5	3	1	2	1%
E	367	0	2	3	2	1%

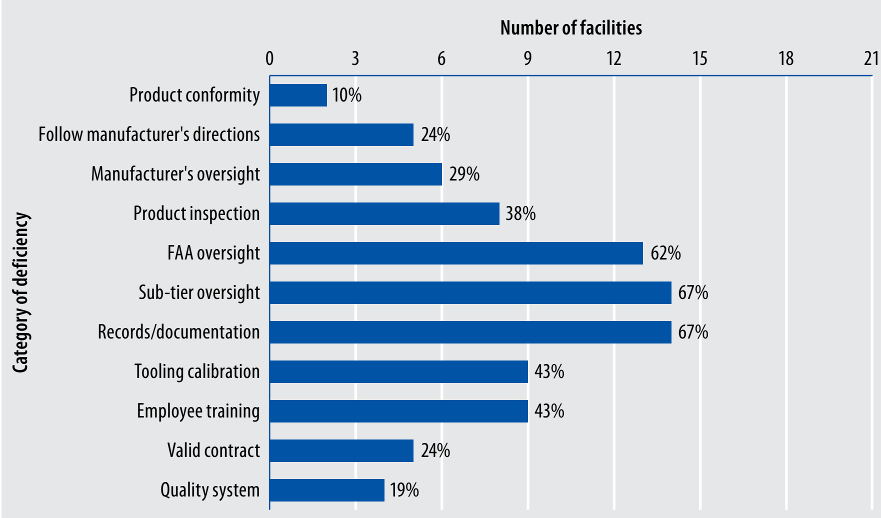
FAA = U.S. Federal Aviation Administration; FY = fiscal year

Note: Number of supplier facilities is based on information obtained for 2004. Manufacturer B operates seven separate manufacturing divisions. As a result, the FAA evaluated the seven divisions separately for risk assessment, which resulted in more supplier control audits. A federal fiscal year runs October–September.

Source: U.S. Department of Transportation, Office of Inspector General

Table 1

Deficiencies Found at Suppliers to U.S. Aircraft Manufacturers



Source: U.S. Department of Transportation, Office of Inspector General

Figure 2

effective tool calibration programs. "Proper tool calibration ensures that equipment used to perform measurements on parts corresponds to universal industry standards, i.e., tools measure accurately," the report said.

One supplier's tracking system showed that 94 percent of its tools were past due for calibration. "Some of the tools were out of date for three to four years," the report said. "There was no procedure to follow up on out-of-date calibrations and no well-defined procedure to address a product that may be inspected or manufactured using improperly calibrated tooling."

Nine suppliers did not have adequate control over employee training and training records, the report said. DOT auditors also found instances of newly hired, untrained employees involved in manufacturing.

"We identified a failure to follow proper procedures during either the parts in process [inspections] or final parts inspections at eight … suppliers," the report said. "We observed one supplier performing unauthorized, undocumented rework of parts. … At another supplier, a receiving clerk showed us a part that did not conform to specifications but then placed the non-conforming part back into the original box and forwarded it to inspection. The non-conforming part was not documented, segregated, tagged or otherwise communicated to the receiving inspection department."

Neither manufacturers nor FAA inspectors were systematic enough, the report said. "We found that FAA inspectors individually determine how and what to inspect at each supplier facility," the report said. "FAA inspectors we observed focused on task-specific items, such as the calibration of one tool, rather than on processes or systems in place at the facility."

The DOT auditors were also concerned that parts destined for U.S. manufacturers, including doors and engine components, were sourced in 15 countries with which the United States does not have a bilateral agreement. "When entering into a bilateral agreement, the United States agrees to accept the oversight of manufacturers provided by that country's [civil] aviation authority, among other things," the report said. "A fundamental consideration in whether or not to enter into a bilateral agreement is the capacity and ability of the foreign civil aviation authority to oversee aviation manufacturing."

The report cited as an example one U.S. engine manufacturer with eight suppliers in Mexico, despite the lack of a bilateral agreement.

"Therefore, FAA has no assurance that these countries are providing adequate oversight of the operations of suppliers in their countries," the report said. "Effective oversight of suppliers is essential to ensure that substandard parts do not enter the aviation supply chain. For example, in February 2003, one supplier released approximately 5,000 parts that were not manufactured properly for use on landing gear for large commercial passenger aircraft. At least one of these landing gear parts failed while in service. While FAA became aware of this large-scale breakdown at this supplier in 2003, it has not performed a supplier audit at this facility in the last four years." ●

Notes

1. "Assessment of FAA's Risk-Based System for Overseeing Aircraft Manufacturers' Suppliers." Report no. AV-2008-026. Feb. 26, 2008. Available via the Internet at <www.oig.dot.gov/item.jsp?id=2246>.

2. The FAA does not have oversight responsibility for Airbus aircraft manufacturing. "However, according to Boeing representatives, 70 percent of the suppliers used by Airbus are also used by Boeing," the report said.

Skills in Depth

For optimum performance, intangibles supplement technical expertise.

BOOKS

Safety at the Sharp End: A Guide to Non-Technical Skills

Flin, Rhona; O'Connor, Paul; Crichton, Margaret. Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2008. 329 pp. Figures, tables, references, index.

Non-technical skills, in this book's context, are the cognitive and social skills that complement technique. In aviation, where engineering design and human technical proficiency are usually reliable, further safety enhancement often depends on improving non-technical skills.

The book is organized under seven headings: situation awareness, decision making, communication, teamwork, leadership, managing stress, and coping with fatigue.

Decision making, frequently cited as a factor in accident reports, exemplifies a non-technical skill that is critically important in aviation safety. It can involve extremely complex situations, multiple sources of information, missing information, unexpected events, several simultaneous stimuli, past experience, time limitations, weighing the odds of possible outcomes, and many other factors for which no classroom or textbook can fully prepare an individual.

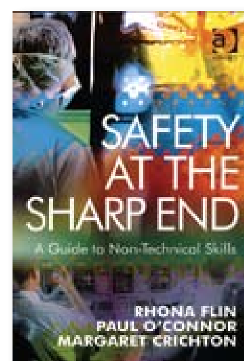
"Decision making in time-pressured, dynamic work environments has attracted the attention of psychologists specializing in the study of human performance. They discovered that classical (i.e., rational or normative) decision theory was of limited application to uncertain, time-pressured settings, where reaching a satisfactory solution to gain control of a problem tends to be the norm — as opposed to trying to reach an optimal or perfect solution."

Dynamic decision making, the kind that operators usually need to perform, can be looked at as a two-stage process: (1) situation assessment, or understanding what the problem is, and (2) choosing a course of action, or deciding what to do.

"The first step of the decision-making process is diagnosing the current situation," the authors say. "At this point, the decision maker, often with a team involved, builds a mental model to explain the situation encountered. … If the situation assessment is incorrect, then it is likely that the resulting decision and selected course of action that is taken in response will not be suitable."

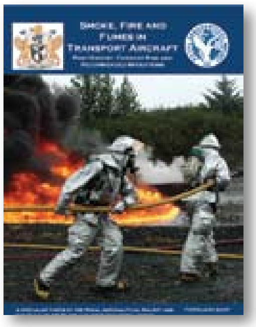
A wrong assessment can result from a number of factors: "Cues in the situation may be misinterpreted, misdiagnosed or ignored, resulting in an incorrect mental picture being formed of the problem. Alternatively, risk levels may be miscalculated or the amount of available time may be misjudged."

The authors cite a study by a psychologist team of pilots' decision making. "They have observed pilots flying in the simulator and have also examined reports of problem situations causing accidents and near-[collisions]," the authors say. The study showed that "the estimation of available time and level of risk during this situation assessment is critical, as this determines the type of decision method the pilot will then adopt. … Where there is very little time and high risk, pilots use faster strategies, such as applying a known rule. When there is more



time (even with variable risk), they may opt for a slower but more rigorous choice method to compare and evaluate alternative courses of action.

"In terms of time estimation, studies from aviation … indicate that experienced practitioners tend to be more accurate with estimates of available time than less experienced colleagues, the latter tending to underestimate this. Experts tend also to be aware of more strategies that they can use to 'buy time' in a problem situation."



Choosing a response to the situation assessment involves four principal methods, the authors say: recognition-primed or intuitive, rule-based, comparison of options and creative.

"In the recognition-primed and rule-based methods, only one response option is considered at a time," the authors say. "In choice decision making, several possible courses of action are generated, then compared simultaneously. In the creative option, the situation is judged to be so unfamiliar that it requires a novel response.

"In some situations, doing nothing or waiting to see what happens may be the optimal course of action. … However, novices typically experience more stress and, as this appears to be relieved by taking action, they are less likely to wait and watch than experienced practitioners."

REPORTS

Smoke, Fire and Fumes in Transport Aircraft: Past History, Current Risk and Recommended Mitigations

Cox, John M. London: Royal Aeronautical Society and the Guild of Air Pilots and Navigators. February 2007. 64 pp. Photographs, appendixes. Available from the Royal Aeronautical Society.*

The danger of in-flight fire was demonstrated as long ago as during the reign of Louis XVI in France. In July 1785, Jean-François Pilâtre de Rozier's hydrogen balloon ignited and burned over the English Channel.

"The occurrence of smoke, fire or fumes aboard a commercial aircraft presents a potentially dangerous situation. Accident data show in-flight fire with the fourth highest number of onboard fatalities and the seventh highest category of accidents," says Cox. "In addition, data from recent years indicate the probability of passengers experiencing an in-flight smoke event is greater than one in 10,000. In the United States alone, one aircraft a day is diverted due to smoke."

This report examines in-flight smoke, fire and fumes (SFF) from multiple angles: originating locations aboard the aircraft, causation, patterns of propagation, detection, protection and barriers, regulations, maintenance, and pilot procedures.

"A review of the past incidents shows that in-flight fires have continued to occur despite the efforts of manufacturers, regulators and operators," Cox says. "Recently the [U.S.] Federal Aviation Administration (FAA) acknowledged that it is unlikely to 'eradicate all possible sources of ignition in fuel tanks,' and they also state, 'The examinations of large transport aircraft … revealed many anomalies in electrical wiring systems and their components, as well as contamination by dirt and debris.' This acknowledgement is important because it shows the need for multiple mitigations to contend with smoke/fire/fumes."

In-flight fire is particularly dangerous because it can do more than destroy areas directly affected by the heat, Cox says. It can also cause cascading failures of other systems: "The proximity of wires within wire bundles can cause seemingly unrelated systems to fail due to arcing and burning of wires within a single wire bundle. As shown in Swissair Flight 111, the shorting, arcing and burning of wire can cause melting and provide a conductive path for electric power to other wires." Flight 111, in 1998, involved a McDonnell Douglas MD-11 in which an in-flight fire led to loss of control, with 229 fatalities.

In a section headed "Location, Location, Location," Cox describes another threat multiplier in SFF — it is often difficult for pilots to discern where the fire is or, in some cases, to gain access to the space with a fire extinguisher. Thick smoke can hide the source of the fire, and fire extinguishers are most effective when aimed at the source or the base of the fire, Cox says.

Although donning protective equipment enables pilots to breathe even in heavy smoke conditions, it is no help for vision. It might seem natural under such stressful and "blind" conditions to open a window to vent smoke, but that can be counter-productive. "In cases of continuous smoke, no manufacturer suggests opening a window, because it can cause the fire to spread," Cox says. "Several serious in-flight fires show that the flight crews opened the window without improving the visibility significantly and, in some cases, it was made worse. An open window creates high wind noise, which prevents effective communication between crewmembers. The high noise level prevents checklist accomplishment and also prevents a crewmember from assisting the flying pilot during the landing with callouts (which may be vital in the limited visibility of a smoke-filled flight deck)."

SFF accident descriptions and scenarios make grim reading. Still, as Cox points out, regulators have progressed toward mitigation. In September 2005, for instance, flammability requirements for thermal acoustic insulation blankets were upgraded by the FAA, a result of work done at the FAA Technical Center on flammability testing and materials flammability resistance. In July 1986, the FAA issued advisory circular (AC) 25-9 to provide guidelines for certification tests of smoke detection, penetration, evacuation tests and flight manual emergency procedures.

"The final version of AC 25-9A was published on 6 January 1994," Cox says. "The revision from the original AC included recommendations for additional regulatory amendments for improved smoke clearance procedures, adherence to updated [U.S. Federal Aviation Regulations] Part 25 requirements, fire protection, lavatory fire protection, addition of a crew rest area smoke detector certification test, use of a helium smoke generator in testing and a paper-towel burn box smoke generator, but not continuous smoke in the flight deck testing." Cox believes that the lack of continuous smoke generation in testing cockpit smoke clearance — smoke production under current guidelines lasts three minutes — is insufficient.

His recommendations for further reducing the likelihood and severity of SFF are grouped under the categories of equipment design and airworthiness, protective equipment, maintenance, pilot procedures and flight crew training. Some recommendations include:

- "Improve the engineering and installation of wires so that the routing does not endanger, by proximity, any critical system wiring. Evaluate modifications using the same approval process for supplemental type certificate modification as for type certificates";
- "Install fire access ports or dedicated fire detection and suppression systems in inaccessible areas of aircraft";
- "Implement vision assurance technology for improved pilot visibility during continuous smoke in the flight deck";
- "Modify maintenance procedures to minimize the possibility of contamination of thermal acoustic insulation blankets";
- "Implement flight crew procedures for using autoflight systems to reduce pilot workload [in an SFF emergency]. There should, however, be provisions in the procedures for the failure or un-serviceability of the autoflight system";
- "Redesign all transport aircraft checklists pertaining to smoke/fire/fumes to be consistent with the Flight Safety Foundation smoke/fire/fume checklist template. Consider: memory items, prevention of checklist 'bottlenecks,' font size and type, where it should be found (quick reference handbook [QRH] or electronic), smoke removal, number of checklists for smoke/fire/fumes, and the length of the checklists"; and,
- "Ensure that flight crew training includes the proper use of a crash ax, the necessity of proper fire extinguisher operation including vertical orientation, the proper accomplishment (or abandonment) of checklists during simulated smoke/fire/fumes events, the importance of maintaining a smoke barrier during smoke/fire/fumes events and the ineffectiveness of, and potential problems with, opening a flight deck window during realistic line-oriented periodic flight training on a recurrent annual basis."

WEB SITES

NATA Safety 1st, <www.natasafety1st.org>

The National Air Transportation Association (NATA), a U.S. association representing aviation business service providers, calls itself "the voice of aviation business." Members include companies owning, operating and servicing aircraft; air taxi and commuter operators; and fractional ownership management companies.

NATA's Web site notes, "NATA has developed Safety 1st, an innovative line-service proficiency testing program that enhances safety by identifying the knowledge and skills required of professional aviation line-service personnel and assuring their competence through objective testing."

The NATA Safety 1st Web site contains a number of materials available to nonmembers that may be downloaded, printed or read online at no cost. Items include:

- More than 50 free safety posters online, which NATA encourages readers to print and use as safety reminders in their operations. Posters concern activities such as aircraft movement, teamwork, ground control, equipment usage and injury prevention;
- Two online safety newsletters, "Flitebag" (2005–present) and "eToolkit" (2004–present) provide industry and association news, plus articles on topics such as safety and complacency, ramp safety, operational best practices, safety management, and communications; and,
- A training resources list that includes a free three-page ramp safety quiz, a training presentation titled "Safety Guidelines for Non-Employees Working the Ramp for Special Events" and links to safety training materials at other Web sites.

The Safety 1st Web site can also be accessed from NATA's Internet home page: <www.nata.aero>.

NAV Canada, <www.navcanada.ca/>

NAV Canada, Canada's civil air navigation services provider, developed local area weather manuals for its flight information centers. Information initially used for internal training purposes is now available to the public.

Each weather manual comprises five chapters and describes the basics of meteorology, aviation weather hazards, weather patterns, seasonal weather and local effects, and airport climatology for six specific forecasting areas: British Columbia; Canadian Prairies; Ontario and Quebec; Atlantic Canada and Eastern Quebec; Yukon, Northwest Territories and Nunavut; and Nunavut and the Artic.

English and French manuals can be read online, downloaded or printed at no charge. Documents reflect geographical formations and terrain of the areas covered. Nevertheless, general information about ice formation, clouds, wind and other meteorological elements may be applicable in other regions of the world. Manuals contain simple graphics to illustrate weather effects on aviation. ●

Source

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— Rick Darby and Patricia Setze

Cleared for a Collision

TCAS and quick pilot action prevented a midair.

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

'Critical Failure of the Human Element'

Boeing 737-800, McDonnell Douglas MD-83. No damage. No injuries.

Nighttime visual meteorological conditions (VMC) prevailed when the 737 and the MD-83 came within 600 ft vertically and 3 nm (6 km) laterally of each other while being flown in evasive maneuvers near the southeast coast of Ireland on Sept. 23, 2007. Collision was avoided by traffic-alert and collision avoidance system (TCAS) warnings and timely compliance by the flight crews of both aircraft with TCAS resolution advisories (RAs), according to the report by the Irish Air Accident Investigation Unit (AAIU).

The 737 was westbound at Flight Level (FL) 300 (approximately 30,000 ft), en route from London to Cork, Ireland, with 179 passengers and six crewmembers. The MD-83 was northbound at FL 280, carrying 164 passengers and six crewmembers from Faro, Portugal, to Dublin. Because of strong southwesterly winds aloft, the MD-83's groundspeed was 517 kt, while the 737's groundspeed was 377 kt. The relative closing speed of the two aircraft was 630 kt, the report said.

Both aircraft were nearing the BANBA reporting point, which is in a Shannon Upper Air Control sector that was being worked by a radar controller who had less than two years' experience and a planning controller who had more than 30 years' experience. The report said that the planning controller pointed out "in a concerned manner" to the radar controller that there was a significant speed difference between the 737 and the MD-83. The planning controller then became engaged in other duties.

The aircraft were 20 nm (37 km) apart when the 737 crew requested clearance to descend. The radar controller initially cleared the 737 crew to descend to FL 290 and then cleared the crew to descend to FL 100 "with a good rate [of descent] through FL 270." During this radio transmission, the air traffic control (ATC) facility's short term conflict alert (STCA) system activated, generating an audio alarm and red highlights on the aircraft data blocks displayed by the radar controller's screen.

The report said that even though the planning controller had pointed out the speed differential and the STCA warnings had activated, "the radar controller appeared not to comprehend the closing speeds of the two aircraft … . What ensued was a critical failure of the human element of the ATC system to rectify this situation."

The descent clearance issued to the 737 crew was read back to the radar controller by the crew of another aircraft en route to Cork. The 737 and the MD-83 were 13 nm (24 km) apart when the controller repeated the descent clearance to the 737 crew. The 737 crew acknowledged the clearance and said that they would "expedite till through FL 270."

In what the report called "a belated attempt to recover the situation," the radar controller told the MD-83 crew to turn right 10 degrees and the 737 crew to maintain FL 290. During this time, however, the MD-83 crew received a TCAS RA to descend, and the 737 crew received an RA to climb. "A potential midair collision was thus narrowly avoided due to the TCAS activation and the correct response of the pilots," the report said. "With separation subsequently re-established by ATC, both aircraft continued onwards and landed at their respective destinations."

Loose Engine Cowling Separates on Takeoff

Airbus A319-111. Minor damage. No injuries.

The A319 was 200 ft above ground level (AGL) on departure from Atlanta the morning of April 22, 2007, when the lower right engine cowling separated, resulting in loss of the airplane's Yellow hydraulic system, said the report by the U.S. National Transportation Safety Board (NTSB). The report did not explain why the Yellow system — one of three independent hydraulic systems in the airplane — was lost.

Examination of the cowling revealed that none of the three latches was fastened.

The flight crew leveled the airplane at 3,000 ft, declared an emergency and received clearance from ATC to return to the airport. The A319, which had 129 people aboard, was landed without further incident.

Examination of the cowling revealed that none of the three latches was fastened. The report said that the latches had been left unfastened by a maintenance technician who had worked on the wheel brakes before the airplane departed. The report also faulted the A319's first officer for not using the "Exterior Inspection" checklist during his preflight walk-around inspection of the airplane.

Incorrect Code Entered in Docking System

Boeing 747SP. Substantial damage. No injuries.

Following a flight from Syria the morning of Dec. 11, 2006, the aircraft was being taxied to a gate at Stockholm/Arlanda (Sweden) Airport when the top of the left wing struck the bottom of the airbridge. The visual docking guidance system at the gate had been programmed incorrectly, said the report by the Swedish Accident Investigation Board.

The airbridge operator had observed the code "74L" displayed for the arriving aircraft by the airport's computer system. This is the International Air Transport Association code for the 747SP. "She was not familiar with this specific code but presumed it was [for] a standard Boeing 747, which her colleagues also assumed," the report said. "At the operator's panel in the airbridge housing, she programmed 'B747' after having deleted … 'B747SP.'"

The airbridge operator told investigators that she had not received training or information about different versions of the same type aircraft, "nor had she been informed about the situations that can arise when entering the incorrect version of certain aircraft types into the panel," the report said.

The 747SP is a lighter, long-range version of the 747 and has a fuselage that is 14.25 m (46.75 ft) shorter. The report noted that because of the longer nose on the standard 747, it "parks about 6 m [20 ft] further forward than the shorter SP version." The visual docking guidance system's laser-scanning equipment, which is designed to confirm that the correct code has been programmed, had not been modified to distinguish among aircraft types that differ primarily in fuselage length.

"The operator supervised the in-taxiing, and when she realized that the aircraft was coming alarmingly close to the airbridge, she activated the emergency stop button," the report said. "The top of the left wing struck the underside of the airbridge at the same time the display indicated 'STOP,' and a large hole was torn in the upper side of the wing."

Hot Approach Results in Overrun

Dassault Falcon 900C. Substantial damage. No injuries.

The flight crew calculated a reference landing speed (VREF) of 128 kt for the approach to Garfield County Regional Airport in Rifle, Colorado, U.S., the night of March 23, 2007. The airport was reporting calm winds, 10 mi (16 km) visibility with rain and a 3,900-ft overcast.

The crew acquired visual contact with Runway 26 before reaching the final approach fix for the instrument landing system (ILS) approach. A performance study indicated that the Falcon crossed the runway threshold at 150 kt — VREF plus 22 kt — and touched down 2,300 ft (701 m) beyond the threshold of the 7,000-ft (2,134-m) runway at 141 kt and with a descent rate of 60 fpm. "Immediately at touchdown, the spoilers were deployed," the NTSB report said. "Approximately four seconds later — and 3,260 ft [994 m] from the threshold — the thrust reversers were fully deployed."

The crew said that the airplane did not decelerate normally. "The pilot knew that they did not have enough runway to execute a go-around," the report said. "With approximately 1,000 ft [305 m] of runway remaining, the pilot pulled the parking brake to the second detent, and the aircraft slid off the end of the runway [at about 65 kt] into the muddy terrain." The Falcon came to a stop in the runway safety area about 268 ft (82 m) from the end of the runway.

Runway 08-26 was not grooved and had a 1.25 percent downslope gradient to the west. The *Airport/Facilities Directory* noted that the runway is "slick when wet" and that the "airport manager recommends landing uphill on Runway 08 when able."

The report noted that the Falcon is among 12 business jets that have overrun Runway 26 since 2001; 11 overruns occurred when the runway was wet, and one involved a hydraulic failure. "Since the [Falcon] accident, the runway has been grooved, and plans are proceeding with a runway-improvement project," the report said.

Depressurization Traced to Corroded Panel

Israel Aircraft Industries 1124 Westwind. Minor damage. No injuries.

The Westwind was climbing through 34,000 ft, en route on a cargo flight from Darwin, Northern Territory, Australia, to Alice Springs on April 2, 2007, when the flight crew heard several loud bangs and noticed the loss of cabin pressure. "The crew donned oxygen masks, closed the aircraft outflow valves and conducted an emergency descent to 10,000 ft," said the report by the Australian Transport Safety Bureau (ATSB). "The aircraft was returned to Darwin."

Examination of the aircraft revealed a hole in a panel on top of the fuselage near the rear of the pressure vessel. "The examination revealed that approximately 60 percent of the panel had been damaged by exfoliation corrosion," the report said. "The damage was most severe at the primary site of rupture, in the center of the panel."

Corrosion had not been expected in this area of the aircraft, and no inspections were required. When the aircraft was built in 1979, a chromate coating was applied to protect the panel from corrosion. "Over time, the coating … had deteriorated, leading to the corrosion of the panel," the report said.

Corrosion had not been expected in this area of the aircraft, and no inspections were required.

The Westwind had been parked outside for several years at airports in coastal environments conducive to corrosion. "Insulation pads affixed to the panel were made of a fibrous material and had the ability to act like a sponge, absorbing the moisture in the humid, salty air," the report said. Corrosion of the panel occurred over a long period of time, reducing the panel's ability to contain pressurization loads.

Control Lost During Maintenance Test Flight

British Aerospace Hawker 800A. Minor damage. Six minor injuries.

Two pilots and four maintenance technicians were aboard the Hawker during a maintenance test flight May 4, 2006, that was to include verification of the airplane's stall characteristics. The flight crew had calculated that the stick shaker would activate at 115 kt, the stick pusher would activate at 107.5 kt, and the aerodynamic stall would occur at 105.5 kt. The stall tests required the crew to fly the airplane on autopilot, to verify that the autopilot would disengage automatically at the onset of the stick pusher.

The crew was operating under instrument flight rules. VMC prevailed, but the airplane was flown through some clouds at 17,000 ft during tests preceding the planned stall series. A maintenance technician told NTSB investigators that a small amount of ice accumulated on the wings during the initial tests.

"The SIC [second-in-command] pilot reported that one of the mechanics had come forward during the flight and informed him that some frost was present on the wings, near the root," the report said. "However, the SIC reported he did not observe any ice form on the aircraft, nor did he observe the icing advisory light during the flight."

The pilot-in-command (PIC), the pilot flying, said that as the Hawker slowed through 126 kt — 11 kt above the expected stick shaker speed — during the first stall test, the airplane abruptly rolled right and pitched nose-down. The SIC said that he "moved to push forward on the controls, to unload the wing" but the PIC told him to stay off the controls. "He stated that the PIC did not unload the wing, and the aircraft kept rolling," the report said.

The Hawker rolled both right and left five to seven times, and entered clouds at about 12,000 ft. The PIC said the airplane was descending vertically when it broke through the cloud layer at about 10,000 ft. He told investigators, "I neutralized the ailerons with the yoke and began a higher-than-normal back-pressure pull-out, experiencing 4 to 5 g [i.e., four to five times standard gravitational acceleration]. The aircraft responded, and we stopped the descent somewhere below 7,000 ft."

The crew returned to Lincoln (Nebraska) Municipal Airport and conducted an uneventful no-flap landing. Examination of the Hawker revealed damage to a wing fairing and interior furnishings but no structural damage or deformation.

NTSB determined that the probable cause of the incident was the PIC's "improper remedial action related to the stall recovery" and that a contributing factor was "initiation of an intentional stall with residual wing ice contamination, resulting in the stall occurring at a higher-than-anticipated airspeed."

Close Call at a Runway Intersection

Embraer 170, Brasilia. No damage. No injuries.

Daytime VMC prevailed when the EMB-170 regional jet and the Brasilia turboprop nearly collided at the intersection of Runway 01L and Runway 28R at San Francisco International Airport (SFO) on May 26, 2007. The Brasilia was on a visual approach, 6 nm (11 km) from Runway 28R, when the SFO tower local controller cleared the crew to land.

The Brasilia was crossing the threshold of Runway 28R when the local controller cleared the 170 crew, who were holding at the approach end of Runway 01L, for takeoff. The airport movement area safety system (AMASS) generated a conflict warning, and the controller radioed the Brasilia crew to "hold, hold, hold."

The Brasilia came to a stop in the runway intersection as the 170 lifted off. "The initial FAA [U.S. Federal Aviation Administration] report estimated the aircraft missed colliding by 300 feet," the report said. "However, the [Brasilia] crew estimated the distance as 30 to 50 feet, and the crew of [the 170] estimated 150 feet. They characterized their estimate as a 'guess,' noting that they could not actually see the Brasilia as they passed over the top of the aircraft." None of the 92 people aboard the two aircraft was injured.

"The local controller involved entered duty with the FAA in 1988 and has been fully certified as a tower controller at SFO since 1999," the report said. "Following the incident, the controller was decertified, required to complete additional training and recertified by SFO management."

TURBOPROPS

Blade Creep Leads to Engine Failure

Embraer Bandeirante. Substantial damage. No injuries.

The aircraft was at about 500 ft AGL during departure from Kununurra, Western Australia, on Dec. 29, 2006, when the right engine failed. "The pilots confirmed the power loss, completed emergency procedures that included shutting down the right engine and returned to Kununurra Airport," the ATSB report said.

Examination of the engine revealed that two compressor turbine blades had separated and that the remaining blades had signs of "significant distress" caused by overheating, the report said. The overheating resulted in a phenomenon called creep, which the report defined as "slow plastic deformation under prolonged load." As the blades deformed, intergranular voids formed and precipitated stress rupture fractures.

Investigators were unable to determine how the compressor turbine had become overheated. "There were no documented engine logbook entries indicating that an overtemperature event of the engine had occurred," the report said, noting that typical causes of such events include fuel flow anomalies, throttle mismanagement, engine trim anomalies, low starting voltage and compressor stall.

Contaminated Switch Blocks Gear Extension

British Aerospace Jetstream 32. Substantial damage. No injuries.

After flaring at the normal height for a landing at Wick (Scotland) Airport on Oct. 3, 2006, the commander noticed that the aircraft continued to sink beyond the expected touchdown point and realized that the landing gear was not extended. The flight crew conducted a go-around, recycled the landing gear and requested and received clearance by the airport traffic controller to fly past the control tower for a visual check of the gear, said the U.K. Air Accidents Investigation Branch (AAIB) report.

During the fly-by, the controller told the crew that the landing gear appeared to be extended. The crew then decided to fly the aircraft, with the landing gear extended, back to Aberdeen Airport, where engineering support was available. The landing was conducted without further incident.

"It was subsequently found that, during the go-around [at Wick], the underside of the fuselage and the tips of the right propeller had contacted the runway surface," the report said. "The impact with the runway did not create vibration or handling difficulties that might have alerted the crew to the airframe and propeller damage. The passengers and the cabin attendant heard a scraping noise, but this information was not passed to the flight crew."

Examination of the landing gear extension system revealed that the selector switch had become contaminated by a piece of cupric oxide formed by mechanical wear and electrical arcing. The contamination had acted as an insulator, preventing current flow to the landing gear extension system and the aural gear-warning system during the approach to Wick. "The three green landing gear indicator lights, which are independent of this circuit, had functioned correctly," the report said. "The crew had not checked the indication prior to landing and were therefore unaware that the landing gear was retracted."

The report said that the contamination was dislodged when the crew recycled the landing gear, allowing the gear-extension system to function normally.

"The passengers and the cabin attendant heard a scraping noise, but this information was not passed to the flight crew."

Cabin Crewmember Falls Through Open Door

ATR 72-200. No damage. One serious injury.

Passenger boarding and cargo loading were suspended temporarily when rain began to fall at Dublin (Ireland) Airport the morning of July 4, 2007. Surface wind velocity was 16 kt, and a strong draft was blowing through the open service doors at the rear of the cabin. A cabin crewmember went to the right aft service door and bent down to look for a baggage loader whom she could ask to close the door.

"Her right foot slipped on the wet metal sill [which is 4.0 ft (1.2 m) above the ground], and she fell," the AAIU report said. "She hit the sill, fell out through the door and struck a baggage trolley." She lost consciousness momentarily and was transported by ambulance to a hospital, where she was found to have sustained extensive bruising and soft tissue damage.

The report said that, after the incident, the manufacturer began installing non-slip mats over the metal sills of the aft service doors in production aircraft and issued service bulletins recommending installation of the mats in aircraft already in service.

Nosewheel Steering Triggers Excursion

Piaggio P-180 Avanti. Substantial damage. No injuries.

After touching down normally on the wet runway at Battle Mountain, Nevada, U.S., the morning of Dec. 7, 2007, the airplane abruptly turned left when the flight crew engaged the nosewheel-steering system just below 60 kt indicated airspeed.

"The crew attempted to correct the turn but were unsuccessful," the NTSB report said. "The airplane completed a 180-degree turn and slid backwards down the runway before it departed the left side of the pavement. The right main landing gear collapsed after sinking in soft mud."

The pilot operating handbook for the Avanti recommends that the nosewheel-steering system be used during takeoff until the airplane accelerates through 60 kt but prohibits use of the system during landing.

"During the interview with the pilots, they said they were unaware of the prohibition against engaging the nosewheel steering during landing," the report said. "They noted that because the steering system is used up to 60 knots during takeoff, they assumed that the [system] was to be engaged after touchdown during the landing roll, while slowing through 60 knots."

PISTON AIRPLANES

Pilot Neglected to Confirm Fuel Order

Britten-Norman Islander. Substantial damage. No injuries.

The pilot had placed a fuel order but did not confirm that the Islander had been refueled before he departed from Salmon, Idaho, U.S., for a charter flight with eight passengers to Stanley, Idaho, on July 15, 2007. "The flight reached its destination without incident, the passengers exited the airplane, and the pilot then departed as the sole occupant of the airplane on a repositioning flight," the NTSB report said.

The pilot said that the airplane was at about 400 ft AGL on initial climb when the left engine "started to sputter." While conducting the "Engine Failure" checklist, the pilot noticed that the airplane yawed left when he closed the left throttle. Deciding that the engine was still producing power, he chose not to shut it down.

The pilot was turning back toward the airport when he heard the right engine begin to sputter and noticed that both fuel quantity indicators were on empty. He said that he decided "to leave all controls forward and gave no further thought to shutting down or feathering either engine," the report said. The pilot then realized that the airplane would not reach the runway, and he landed it in an open field, where it struck a ditch.

Engine Fails Above Ice-Covered Water

Cessna 207A. Substantial damage. One fatality.

Ambient surface air temperature was minus 20 degrees F (minus 29 degrees C), and there was no survival equipment aboard the single-engine airplane when it departed from Kenai, Alaska, U.S., for a cargo flight to Kokhanok the morning of Jan. 9, 2007. Ten minutes later, the pilot declared an emergency and told the Kenai airport traffic control tower that the Cessna was halfway across Cook Inlet, vibrating substantially and descending.

The NTSB report said that the engine had failed because of "disintegration of engine bearings and the fracture of a connecting rod." The airplane was 1,500 ft over the inlet, which is about 22 nm (41 km) wide, when power was lost. "A review of the manufacturer's maximum-glide-distance chart revealed that from an altitude of about 1,500 feet, the airplane could glide about 2.1 nm [3.9 km]," the report said.

The report indicates that the Cessna touched down on a floating sheet of ice and ran off the edge of the ice, into the water. "Expected survival time in the 29-degree-F [minus-2-degree-C] ocean water was about 30 minutes," the report said. "The airplane was located about two hours after the accident, floating nose-down next to a segment of pan ice. … The pilot was not recovered with the airplane, and subsequent searches did not locate him."

Neglected Service Cited in Gear-Up Landing

Cessna 402C. Substantial damage. No injuries.

During a cargo flight on Feb. 20, 2007, the airplane veered right after touching down on a hard-surfaced runway at Cordova, Alaska, U.S., and the pilot was unable to regain directional control. The right main landing gear collapsed.

The NTSB report said that examination of the 402's right main landing gear revealed that a bolt had pulled through a washer, disconnecting the scissor link from the strut and allowing the wheel assembly to pivot and become overloaded.

Cessna had issued a service letter, ME-83-37, recommending replacement of the washers with larger and stronger washers. "The operator [of the 402] had not complied with the nonmandatory service letter, and the airplane was operated with the smaller washers," the report said.

HELICOPTERS

Fire Erupts During Refueling

Eurocopter EC 155-B1. Minor damage. No injuries.

After picking up passengers at several North Sea platforms, the helicopter was landed at Norwich (England) Airport on March 10, 2007. "After disembarking the passengers on the operator's ramp at Norwich, a rotors-running refueling was commenced," the AAIB report said.

During the refueling, the flight crew detected an unusual odor and asked an engineer to investigate. The engineer saw smoke and flames emanating from the hoist connector on the upper right side of the fuselage. "He signaled to the commander to shut the aircraft down and stopped the refueling," the report said. The fire went out when the flight crew shut down the engines and electrical system.

The fire was traced to a short in the electrical connector for the removable electric hoist. "The short was probably caused by moisture ingress into the connector due to a damaged seal," the report said. "A contributory factor was that the connector is always live whenever the electrical system is powered."

Crewmember Lifted by Tangled Helmet Cord

Hughes 369D. No damage. One serious injury.

The helicopter was engaged in netting and collaring elk calves near Troy, Utah, U.S., the night of June 6, 2007. After landing near the staging area, the pilot saw one of the two crewmembers unbuckle his seatbelt, unplug the communication cord from his helmet and exit the helicopter. When the pilot initiated a vertical takeoff, he could not see the crewmember.

"About 10 to 15 feet above the ground, the pilot sensed something similar to a load being released from the helicopter and, after repositioning the helicopter, he observed the crewmember in an apple tree," the NTSB report said.

The communication cord on the crewmember's helmet had become entangled somewhere on the helicopter, and the crewmember was pulled aloft when the helicopter ascended, the report said. The cord then separated, and the crewmember fell into the tree.

Bearing Failure Causes Loss of Control

Schweizer 300C. Minor damage. No injuries.

The helicopter was at about 50 ft AGL on a downwind approach to land at Weston (Ireland) Airport during a training flight on March 12, 2006, when the flight instructor and student pilot felt a vibration and the nose rapidly yawing right. "Full left pedal was applied, but this had no effect," the AAIU report said. "The pilot then realized that he had a loss of tail rotor control and immediately entered autorotation."

The helicopter slid about 7 m (23 ft) after being landed on a grassy area. "Examination of the tail rotor blade pitch change mechanism showed that the double-row ball bearing installed in the bellcrank had disintegrated," the report said. "This allowed the bellcrank to slip through the pivot bolt, including its washer and nut, and separate from the tail rotor gearbox."

The manufacturer determined that corrosion had caused the bearing to fail. "The helicopter had accumulated approximately 770 hours in less than three years since construction," the report said. "The bellcrank pivot bearing is a sealed bearing and is not lubricated in service."

Based on the incident, Schweizer in October 2006 issued a mandatory service bulletin, C1B-019, requiring an inspection of the bearing and installation of a safety washer to prevent bellcrank separation. ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
March 4, 2008	Oklahoma City	Cessna Citation I	destroyed	5 fatal
Visual meteorological conditions (VMC) prevailed when the Citation crashed soon after taking off from Wiley Post Airport. Witnesses heard sounds similar to an engine compressor stall and saw smoke trailing from the airplane before it struck wooded terrain.				
March 6, 2008	Wamena, Indonesia	Transall C-160NG	destroyed	8 none
The twin-turboprop airplane burst into flames after landing with a cargo of food and diesel oil.				
March 8, 2008	Stuart, Florida, U.S.	Cessna 525B	NA	2 none
The copilot had pulled the braking system circuit breaker to prevent the hydraulic motor from cycling while he updated a navigation database and had neglected to reset the circuit breaker before start-up. The CJ3 struck a parked airplane while being taxied for departure.				
March 10, 2008	Mercury, Nevada, U.S.	Cessna 402C	substantial	1 none
The pilot conducted a gear-up emergency landing at the unlighted airport after both engines lost power at 15,000 ft during a nighttime cargo flight.				
March 11, 2008	Cajamarca, Peru	Bell 412B	destroyed	10 fatal
The helicopter was ferrying workers from a copper mine to Chiclayo when it crashed in the Andes.				
March 15, 2008	Nigeria	Beech 1900D	NA	3 NA
The airplane was reported missing on a positioning flight from Lagos to Obudu. The search was continuing at press time.				
March 19, 2008	Mannheim, Germany	Dornier 328	substantial	27 NA
The airplane overran the runway on landing and struck an earthen wall. No fatalities were reported.				
March 20, 2008	Portland, Oregon, U.S.	Piper Chieftain	substantial	1 none
The pilot was unable to fully extend the landing gear and landed the cargo airplane with the right main gear retracted. The preliminary report said that an actuating rod pivot bolt had not been installed properly during recent maintenance.				
March 21, 2008	Idaho Falls, Idaho, U.S.	Beech King Air	minor	6 none
VMC prevailed when the King Air overran the runway during an attempted go-around.				
March 22, 2008	near Baltimore	Boeing 757	substantial	180 none
The 757 was at 27,000 ft during a flight from Orlando, Florida, to Philadelphia when a 4- by 5-ft (1- by 2-m) composite panel separated from the top of the left wing and struck several cabin windows, cracking the outer pane of one window.				
March 24, 2008	Tel Aviv, Israel	Boeing 767-300	minor	NA
Several hours after a nighttime takeoff, the flight crew was notified by airport authorities that a main landing gear tire had burst on takeoff. After sunrise, crewmembers and passengers noticed a hole in the inboard spoiler on the left wing that apparently had been made by tire fragments. The 767 was landed without further incident in Toronto.				
March 24, 2008	Grand Junction, Colorado, U.S.	Canadair Challenger	substantial	2 none
Soon after departure, the crew declared an emergency and returned to the airport. As the Challenger was rolling out on landing, airport air traffic controllers noticed that the main cabin door was missing.				
March 25, 2008	Dhaka, Bangladesh	Boeing 747-300	minor	307 none
The no. 3 engine caught fire while landing at Zia International Airport.				
March 26, 2008	Recife, Brazil	Learjet 35A	substantial	5 none
Soon after takeoff, the crew reported landing gear problems and that they were returning to the airport for an emergency landing. The left main gear failed on touchdown, and the Learjet went off the side of the runway.				
March 27, 2008	Bangalore, India	ATR 72	minor	25 none
The nosegear collapsed after striking a black dog during a nighttime takeoff.				
March 28, 2008	Wainwright, Canada	Piper Malibu Mirage	destroyed	5 fatal
The pilot reported unspecified problems with the single-engine airplane soon before it descended rapidly and struck terrain during a flight from Edmonton to Winnipeg.				
March 30, 2008	Farnborough, England	Cessna Citation I	destroyed	5 fatal
The pilot declared an emergency soon after takeoff from Biggin Hill Airport in London and said that he was diverting to the Farnborough airport. The Citation crashed into several unoccupied houses near the airport.				

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.

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