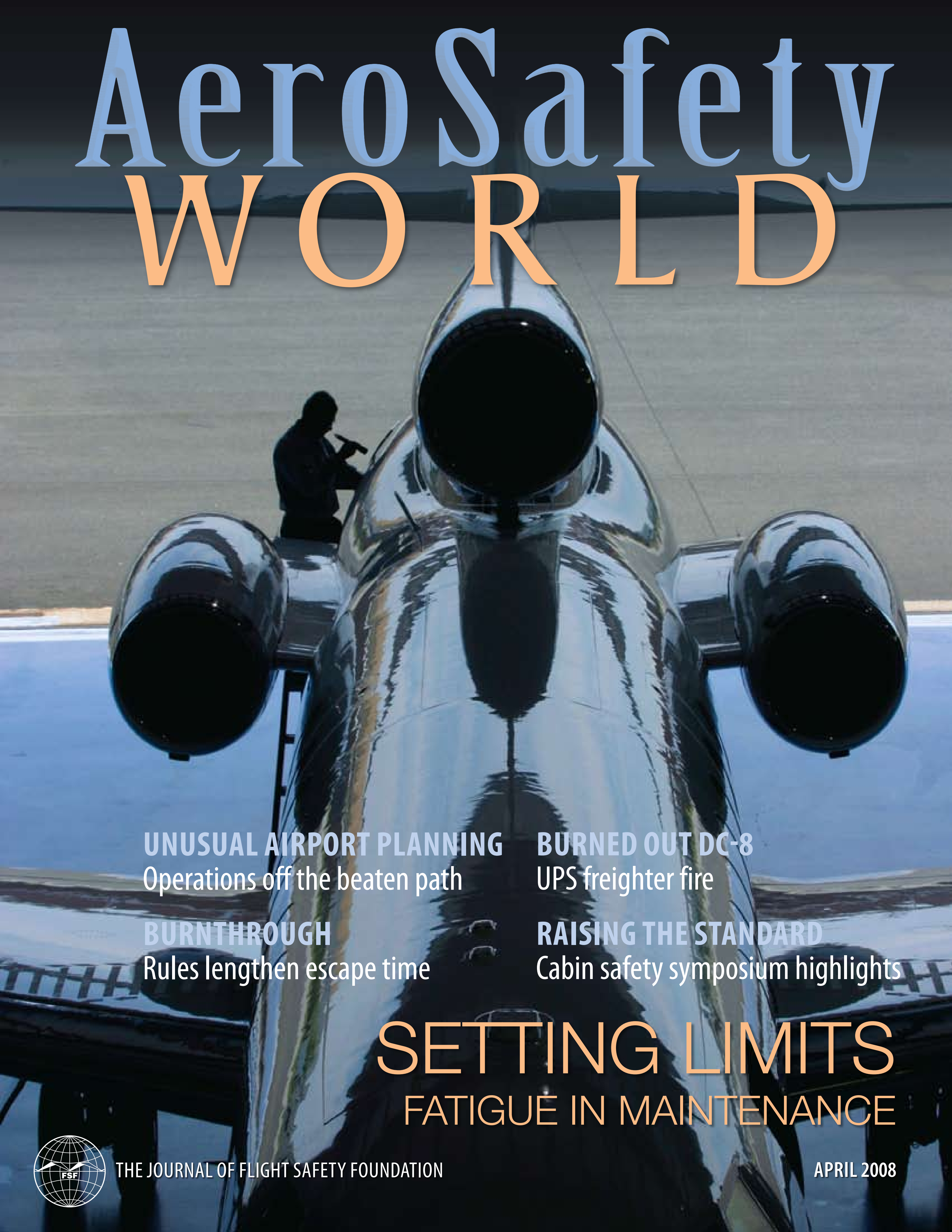


AeroSafety WORLD

UNUSUAL AIRPORT PLANNING
Operations off the beaten path

BURNED OUT DC-8
UPS freighter fire

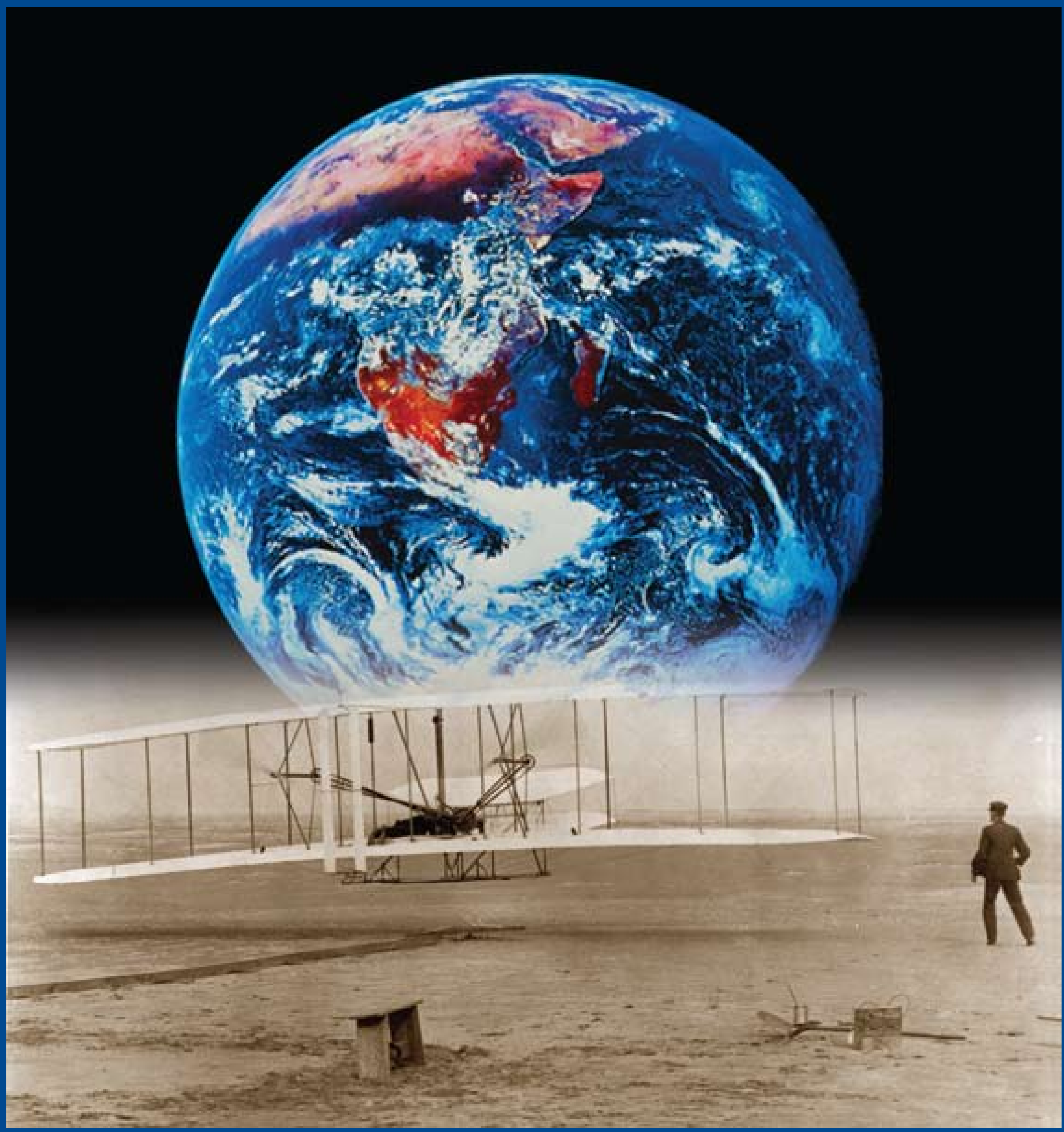
BURNTHROUGH
Rules lengthen escape time

RAISING THE STANDARD
Cabin safety symposium highlights

SETTING LIMITS
FATIGUE IN MAINTENANCE

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

APRIL 2008



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

BEYOND Competition

Last month, Flight Safety Foundation announced a partnership with the International Air Transport Association (IATA) on its personnel training and qualification initiative. Since then, I have been asked how and why the Foundation would get involved in the difficult issues involved in the looming global shortage of qualified personnel.

First, it is important that the problem be addressed from a safety and quality perspective, and not just from a commercial or competitive standpoint which, at its most basic level, is just making sure the other guy runs out of pilots first. That is not the right answer for our industry or the people we serve. The Foundation wants to keep the focus on the innovations and safety improvements that the industry will have to deliver on its way to doubling in size over the next 20 years.

But while we begin to act on future challenges, we can't lose focus on what is happening today. Last year, for the first time in decades, loss-of-control accidents surpassed controlled flight into terrain as the number one killer in aviation. Did growth pressures, lowered qualifications for hiring, or changes in crew interactions have something to do with that? I don't know, but I am sure the question cannot be ignored.

This industry spent decades implementing crew resource management. The resulting safety gains could dissipate quickly if communication in the cockpit falls apart because of generational gaps, culture gaps or knowledge gaps. I expect a number of accident reports during the coming 12 months will make us think hard about that.

One last reason that the Foundation is getting in the middle of this problem is that it touches every part of the industry. We are the only organization positioned to reach across all segments of the professional aviation industry. The shortage of qualified personnel must be addressed in a systematic way that meets the needs of the *whole* industry. For the next 10 years, a new business jet will be delivered for every airliner produced, and each will create its own demand for qualified operators.

If regional carriers run out of people, smaller communities will lose service. If the major pilot training centers run out of instructors, there will be pilot supply problems around the world. If government regulators can't retain qualified inspectors, no one will be left to safeguard industry growth.

You can bring this problem closer to home: If you fall ill in the Australian outback, you expect that an experienced pilot will be there to fly you to the hospital. If my child is in an accident, I hope a talented pilot is there to fly her to the trauma center.

The point is simple. It is time to drop our competitive instincts and look for solutions that work for everybody. IATA and the Foundation have started working on this together with the hope that others will join in. Maybe if we take this on together, we will start looking like an industry that young people once again will want to join.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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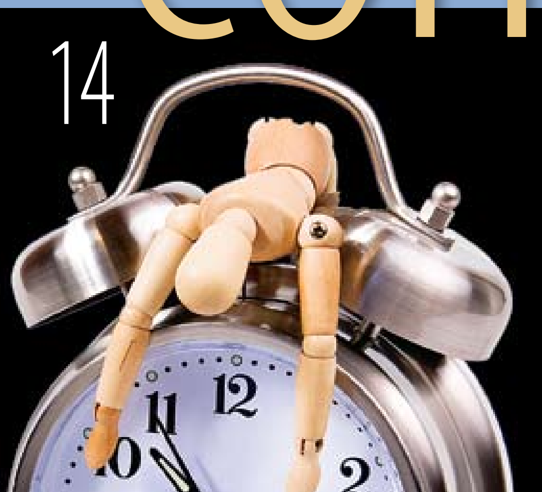

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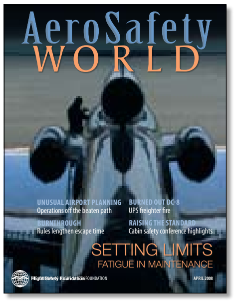

About the Cover
Work limits seek to reduce maintenance errors.
Photo Illustration: © Chris Sorensen Photography

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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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PROTECTING Confidentially

The problem with trying to explain the things that we do in the aviation industry is that many levels of information usually need to be known before understanding becomes possible. That's one of the reasons the general news media get aviation stories wrong. To be sure, there are dedicated reporters who know aviation well and are very good, and most general assignment reporters try to get it right, but sometimes deadlines get the better of them.

While much of the misunderstanding about what we do is technology-based, when it comes to explaining how we got to where we are in keeping aviation safe, the path to understanding is even more tortured. The medical industry — not a group of dummies — still is struggling to distill our multi-layered risk reduction schemes into something it can intellectually accept and practically adopt.

That knowledge gap became a factor when attorneys in February asked Magistrate Judge James B. Todd to unlock Comair's aviation safety action program (ASAP) records to see if the airline's management knew of any unsafe conditions that, if corrected, might have prevented the 2006 runway confusion accident in Lexington, Kentucky, U.S. (*ASW,* 11/07, p.38).

Various aviation groups tried to explain why violating the confidentiality of Comair's ASAP is a bad idea, but to no avail. In ordering that the information be released, Todd said that the program would persist because it is so important. He could say something like that because he wasn't aware of — or couldn't appreciate — the difficulty U.S. operators had in getting legal clearance for the Federal Aviation Administration to allow confidentiality protection, then selling the idea to their employees. Todd further said, according to one report, that instead of companies and individuals being afraid of what legal damage ASAP disclosure might cause, they should be more afraid of increased risk and lawsuits if the program was shut down.

That logic, to my eye, is how we used to look at safety: Try real hard not to crash because lots of bad things accompany accidents. Then we discovered the benefits of data-based action plans, protected reporting systems and just culture, and a new level of safety was achieved.

Further, there seems to be little chance that giving a bunch of smart lawyers access to information about hundreds of incidents, misunderstandings and close calls will result in anything positive. How can an airline's handling of ASAP reports be defended? And with what standard, reasonable diligence or zero tolerance?

It seems that the battle against criminalizing accidents and opening up confidential reporting systems cannot be fought solely on a case-by-case basis, although that must be part of the plan. But to better protect a proven system against well-meaning legal actions with potentially devastating results, laws must be changed to set limits, establish boundaries of what is fair game and what is too important to the lives of countless future passengers to be subject to the whims of local legal forces. That will be a tough sell, but it is well worth the effort.

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

A Challenge From Africa

Thank you for the invaluable contribution that Flight Safety Foundation is providing to the aviation world. I feel that flight safety in Africa is being neglected due to lack of information, corruption, economic reasons and because there is lack of enforcement from the aviation authorities. The fact that the Foundation and many others are available on line does not directly translate to information being at the fingertips of those who earnestly need it. Flight safety in Africa is deplorable and something needs to be done about it.

I have been in aviation for about 20 years. I am focusing now on aviation safety and want to make a contribution specifically to safety in Africa. I am a Kenyan and currently work in Djibouti as an airline operations manager. I hold a Kenyan air traffic control license.

There are very few African safety forums that seriously look at improving safety of the African skies, and that is where Flight Safety Foundation comes in. How can we pioneer a reputable African safety organization with the backing of FSF that will fight for the enforcement, training, auditing, reviews, etc. of flight safety in African countries? Now that aviation is moving towards safety management systems, how will Africa fit in without the expertise in this field?

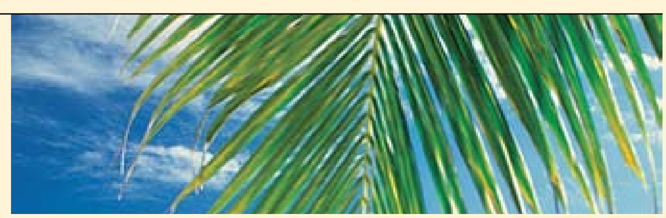
Sir, this is my challenge to Flight Safety Foundation.

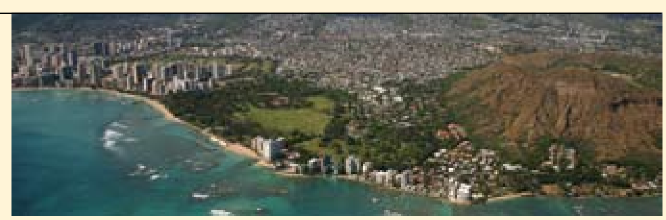
David Muthoka
Daallo Airlines

FSF President and CEO William R. Voss replies: Mr. Muthoka, I am very familiar with the challenges you face in Africa, based primarily on my previous position as director of the ICAO Air Navigation Bureau. The Foundation is also up to speed on the situation and actively involved. We are working with ICAO on their plans for Africa, and trying to obtain funding from certain Middle Eastern states for improvement of the African aviation infrastructure. We have joined forces with the recently established AviAssist Foundation in Zambia.

Last year, the Foundation presented a President's Citation for Outstanding Service to Maimuna Taal, the former director general of the Gambia Civil Aviation Authority, who refused permission for an operator to fly unairworthy 747s from her country. She paid the price of being dismissed and jailed, although she was eventually acquitted of the charges. Through this award and efforts to see that she is properly recognized and employed, we intend to let regulators know that they are not alone when they stand up to political pressure.

Thank you for the challenge. There is a great deal that needs to be done, but we are on the job.





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APRIL 1–3 ➤ Aircraft Interiors Expo. Reed Exhibitions. Hamburg, Germany. <www.aircraftinteriorsexpo.com>, +44 (0)20 8271 2174.

APRIL 2 ➤ IATA Food Safety Forum. International Air Transport Association. Miami. <inflight@iata.org>, <www.iata.org/events/fsf08/index.htm>.

APRIL 14–17 ➤ 59th Annual Avionics Maintenance Conference. ARINC. Tulsa, Oklahoma, U.S. Samuel Buckwalter, <Samuel.Buckwalter@arinc.com>, <www.aviation-ia.com/amc/upcoming/index.html>, +1 410.266.2008.

APRIL 15–17 ➤ Maintenance Management Conference. National Business Aviation Association. Daytona Beach, Florida, U.S. Dina Green, <dgreen@nbaa.org>, <web.nbaa.org/public/cs/mmc/200804/index.php>, +1 202.783.9357.

APRIL 18–22 ➤ IFALPA 2008: 63rd Conference. International Federation of Air Line Pilots' Associations. Mexico City. <ifalpa@ifalpa.org>, <www.ifalpa.org/conference/index.htm>, +44 1932 571711.

APRIL 22–24 ➤ World Aviation Training Conference and Tradeshow. Halldale. Orlando, Florida, U.S. Chris Lehman, <chris@halldale.com>, <www.halldale.com/wats>.

APRIL 23–26 ➤ AEA Convention and Trade Show. Aircraft Electronics Association. Washington, D.C. <info@aea.net>, <www.aea.net/Convention/FutureConventions.asp?Category=6>, +1 816.373.6565.

APRIL 29–MAY 1 ➤ 53rd annual Corporate Aviation Safety Seminar (CASS). Flight Safety Foundation and National Business Aviation Association. Palm Harbor, Florida, U.S. Namratha Apparao, <apparao@flightsafety.org>, <www.flightsafety.org/seminars.html#cass>, +1 703.739.6700, ext. 101.

MAY 5–7 ➤ Airport Fire-Rescue USA: 5th International Aircraft Rescue Fire Fighting Conference and Exhibits. *Aviation Fire Journal*. Myrtle Beach, South Carolina, U.S. <www.aviationfirejournal.com>, +1 914.962.5185.

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 (Canada and United States).

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 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 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, Oklahoma, U.S. Mary Waggoner, <mwaggonr@ou.edu>, <www.ifis2008.com>, +1 405.325.3760; 800.203.5494.

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>.

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

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.

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.

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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Safety News

Fan Blade Warning

The U.S. National Transportation Safety Board (NTSB), citing failures of General Electric (GE) CF34-3B1 turbofan engines on two Bombardier CRJ200s, is recommending that aviation authorities in the United States and Canada take steps to remove from other GE regional jet engines any fan blades that were the products of a faulty manufacturing process.

Both engine failures involved fan blades that fractured because of a material defect introduced when the blades were forged, the NTSB said. The blades were among 28,000 manufactured by Teleflex Aerospace Manufacturing Group in San Luis Potosí, Mexico.

The NTSB said that it issued the recommendations because of its concern that "until the fan blades with the forging problem are removed from service, undercowl fires are likely to result from damage caused during these events."

No one was injured in the two incidents, both of which ended with safe emergency landings, and there was no airplane structural damage, the NTSB said.

The first incident occurred July 27, 2006, on an Air Nostrum CRJ200 as it climbed through 23,000 ft after departure from Barcelona, Spain; the crew discharged both fire bottles after receiving a no. 1 engine fire warning. At the time, the blade had accumulated 10,896 hours and 8,899 cycles since new.

© Bombardier

The second occurred May 24, 2007, on an Atlantic Southeast Airlines CRJ200 in cruise at 23,000 ft en route from Syracuse, New York, U.S., to Atlanta. The blade had accumulated 5,845 hours and 4,717 cycles since new.

The recommendations to the U.S. Federal Aviation Administration (FAA) included a call to require GE Aviation to "define a reasonable maximum time frame below 4,717 cycles since new for these Teleflex fan blades and require that the blades be removed from service before that limit is exceeded." A similar recommendation said that Transport Canada should require Bombardier to redesign a portion of the engine throttle gearbox on CRJ100s and CRJ200s "to ensure that it can withstand the loads generated by a fan blade separation or similar event."

Voluntary Reporting at Risk?

Pilots' organizations say voluntary safety reporting systems are jeopardized by a judge's decision to allow reports from Comair's aviation safety action program (ASAP) to be scrutinized as part of a crash liability case.

The decision by U.S. District Court Judge Karl Forester involves several lawsuits filed against Comair as a result of the Aug. 27, 2006, crash of a Bombardier CRJ100ER during an attempted takeoff in Lexington, Kentucky, U.S. The crew had inadvertently taxied onto an incorrect runway — only half as long as the runway that had been assigned for takeoff. Forty-nine of the 50 people in the airplane were killed, and one — the first officer — received serious injuries.

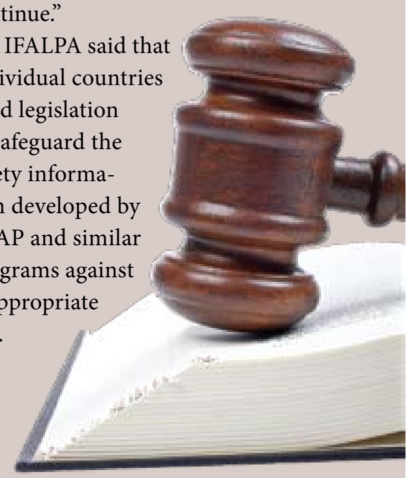
John Prater, president of the Air Line Pilots Association, International (ALPA), said the judge's decision "undoes a lot of hard work we've all accomplished in airline safety and sets us back by decades."

Comair's ASAP — like similar programs at other airlines — is designed as a confidential reporting system under which airline employees are encouraged to report perceived safety problems, including their own errors, without fear of punishment.

"Our passengers get more benefits from nonpunitive safety reporting programs like the one this judge is undermining than virtually any program in aviation safety," Prater said. He said that if ASAP data are released, "it will bring pre-emptive, proactive safety solutions in our industry to a screeching halt."

The International Federation of Air Line Pilots' Associations (IFALPA) agreed, describing ASAP as "one of the best opportunities to continuously improve the safety and efficiency of the air transport system. Because the maintenance of such systems requires individuals and organizations to be very forthcoming, there has always been a concern that inappropriate use of the program output could possibly have a chilling effect on the willingness to continue."

IFALPA said that individual countries need legislation to safeguard the safety information developed by ASAP and similar programs against inappropriate use.



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Simulated Air Traffic Towers

The U.S. Federal Aviation Administration (FAA) has expanded its use of air traffic control tower simulators in the training of new air traffic controllers. Tower simulators, which were first used in 2006, are being deployed at 19 additional locations, the FAA said.

The simulators are intended to incorporate the latest technology into the training program, said FAA Acting Administrator Robert A. Sturgell. "Experience tells us that real-life training scenarios make a critical difference," Sturgell said.

The tower simulation system includes a large graphic depiction of the airport and surrounding areas, and can be adjusted for different weather and lighting conditions. Synthetic voice response and voice recognition allow student controllers to give and receive responses as they would in a control tower. The simulator does not involve actual air traffic control operations.

U.S. National Aeronautics and Space Administration

Flight Deck ADS-B

Airbus and ACSS have agreed to certify ACSS's T3CAS — a system that combines a traffic-alert and collision avoidance system (TCAS), terrain awareness and warning system (TAWS) capability and a Mode S transponder in a single unit — on Airbus single-aisle and long-range airplanes.

©ACSS

ACSS said the integrated platform for Airbus will include automatic dependent surveillance–broadcast (ADS–B) capability.

The agreement will make T3CAS standard equipment on A318/319/320/321 and A330/340 airplanes, ACSS said.

ADS-B Sites Proposed

Airlines participating in a Eurocontrol project have identified 70 airports in Europe where automatic dependent surveillance–broadcast (ADS–B) would be most useful. Under the ADS–B Pioneer Airlines Project, Eurocontrol will discuss with air navigation service providers (ANSPs) whether implementation of ADS–B at those airports would be feasible.

Many of the airports are in countries where ANSPs have been participating with Eurocontrol in ADS–B trials: Austria, France, Germany, Greece, Italy, Sweden, Turkey and the United Kingdom. Other airports are in Norway, Moldova, Romania, Spain and Ukraine.

Most of the airports currently are without surveillance-based air traffic control service and are locations where the introduction of radar would be difficult and costly, Eurocontrol said.

The ADS–B Pioneer Airlines Project, begun in 2007, is intended to help airlines obtain airworthiness approval for existing ADS–B equipment.

Penalty Proposed for Inspection Failure

The U.S. Federal Aviation Administration (FAA) has proposed a US$10.2 million civil penalty against Southwest Airlines for operating 46 Boeing 737s that had not undergone mandatory inspections for fatigue cracking in the fuselage.

The FAA said that Southwest did not comply with a September 2004 airworthiness directive that required repetitive inspections of some fuselage areas to detect fatigue cracks. The violations occurred from June 18, 2006, to March 14, 2007; during that period, the airplanes were operated on 59,791 flights, the FAA said. The FAA said that, after Southwest discovered that the required inspections had not been informed, it continued to operate the airplanes until March 23, 2007, on an additional 1,451 flights.

Southwest said that the proposed penalty concerns "one of many routine and redundant inspections" that involved "an extremely small area in one of the many overlapping inspections" designed to detect early indications of cracking.

The company said that after discovering the missed inspection area, it disclosed the matter to the FAA and re-inspected the airplanes in March 2007. Safety of flight was never an issue, the airline said.

© Southwest Airlines

Cockpit Smoke Solution

According to Air Safety Week, at least once a day somewhere in North America a plane has to make an unscheduled or emergency landing because of a smoke and in-flight fire event.

Statistics from FAA Service Difficulty Reports clearly show that in-flight fires, smoke or fumes are one of the most significant causes of unscheduled or emergency landings and account for 3 precautionary landings per day based on 1,089 events during a 10 month period in 1999.

A pilot encountering smoke in the cockpit so thick that the instruments cannot be seen can utilize a relatively simple device, which provides a clear view.

a Jeppessen navigation manual. When needed, the pilot removes the IVU (Inflatable Vision Unit) from the EVAS case and pulls a tab to activate the system. The IVU inflates with one lobe above and one below the glareshield. According to EVASWorldwide, the manufacturer, the whole process takes 15-20 seconds. The pilot leans forward, placing his smoke goggles in contact with the EVAS clear window, giving him an unimpaired view of both vital instruments and the outside world.

After it is activated, EVAS is continually pressurized with filtered cockpit air to

EVASWorldwide uses a fleet of mobile cockpit demonstration units to show potential customers the benefits of the system. EVAS demonstrations use a fog generator to reduce cockpit vision so the pilot cannot see his hand in front of his face. Smoke goggles offer no vision improvement, though they do protect the eyes. After EVAS is deployed, the pilot can clearly see both the vital instruments and out through the windshield. It is truly an amazing experience. Most pilots are sold on the benefits of EVAS on the spot.

Normal cockpit visibility

Uncontrolled smoke in the cockpit –No visibility

Uncontrolled smoke in the cockpit –Visibility with EVAS

The Emergency Vision Assurance System (EVAS) provides a clear space of air through which a pilot can see flight instruments and out the front windshield for landing. The pilot still relies on the oxygen mask for breathing, smoke goggles for eye protection and employs approved procedures for clearing smoke from the aircraft. When smoke evacuation procedures are not sufficient, EVAS provides emergency backup allowing the pilot to see and fly the aircraft to a safe landing.

EVAS measures 3 x 8.5 x 10 inches when stowed, the approximate space of maintain volume, and preserve a clear view. The device is independent of aircraft power, relying on a self-contained battery-power supply, pump and filters in each storage case. EVAS systems are designed to run for at least two hours, and filter down to .01 microns. The system requires virtually no installation.

While FAA regulations require smoke detectors, fire extinguishers, smoke goggles and oxygen masks, pilots point out that these safeguards and all other systems and equipment for flight safety are useless if the pilots cannot see to control and land the aircraft.

EVAS™ Worldwide
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CURRENTLY SEEKING LAUNCH AIRLINE CUSTOMER

Increasing Errors

Operational errors involving reduced vertical separation minimum (RVSM) aircraft being flown at incorrect flight levels are increasing, according to a report by Eurocontrol.

The 2007 European RVSM Safety Monitoring Report showed a continued increase, which was attributed to erroneous actions by both air traffic control (ATC) and flight crews and to incorrect planning by aircraft operators.

The International Federation of Air Line Pilots' Associations (IFALPA), in its analysis of the information, said that the errors included ATC issuance of clearances to incorrect flight levels or to aircraft not approved for operations in RVSM airspace and, ATC failures to detect and correct pilots' erroneous readback clearances, as well as flight crew failures to obtain ATC clearance for climbs or descents, or failures to climb in compliance with ATC instructions.

IFALPA said that countries and air navigation service providers should ensure that measures exist to "facilitate the early detection of any trends adverse to the safety of aircraft operating in RVSM airspace and the development and implementation of appropriate mitigations aimed at reducing operational risk, and that all factors that contribute to the operational errors in RVSM airspace are addressed."

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Training Initiatives

The Civil Aviation Safety Authority of Australia (CASA) has begun implementing new flight training initiatives, which CASA CEO Bruce Byron says are designed to "[get] the regulator involved in some flight tests and [work] more closely with approved testing officers."

The initiatives will include the establishment of a national office of flight training examiners, who will oversee flight training and take over the testing of some pilots, including flight instructors. The new office will oversee approved testing officers and monitor their professional development, Byron said.

"CASA has no intention of taking over all flight tests," he said. "Rather, these initiatives strengthen the relationship between the regulator and approved testing officers in support of our shared interest in safety."

The initiatives are part of an ongoing effort to increase CASA's emphasis on flight training and to press for "even higher standards of performance."

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In Other News …

Eurocontrol has released guidance material to help air navigation service providers develop contingency plans for dealing with "challenging circumstances," including disruption of service. … The **U.S. Federal Aviation Administration** has amended flight data recorder regulations to increase the duration of some cockpit voice recorder (CVR) recordings and increase the recording rate for digital flight data recorders (*ASW*, 01/08, p. 47). The changes are intended to improve the quality of recorded information and "increase the potential for retaining important information needed for accident and incident investigations," the FAA said.

Correction … A story in the March 2008 issue incorrectly stated the Internet address for lithium-battery safety guidance from the U.S. Department of Transportation; the correct address is <http://safetravel.dot.gov>.

Compiled and edited by Linda Werfelman.


LOOKING FOR A
RELIABLE CO-PILOT?
WE'VE BEEN IN
THE RIGHT SEAT
FOR OVER 60 YEARS.

Slowly but surely, operators and regulators are implementing programs to prevent fatigue among aviation maintenance personnel.

BY LINDA WERFELMAN

WORKING to the Limit

Although aviation maintenance personnel typically work long hours, often at night, they rarely are included in aviation industry programs to fight fatigue. Duty time limits and other efforts to address fatigue typically are intended for flight crews — not maintenance personnel.

Nevertheless, in recent years, some civil aviation authorities and operators have taken steps to ensure that maintenance personnel are not pushed beyond their limits.

The International Civil Aviation Organization (ICAO), in its 2003 manual for maintenance human factors, said that fatigue among aviation maintenance personnel has resulted from "excessive hours of work, poor planning, insufficient staff, bad shift scheduling and a working environment with no proper control of temperature, humidity or noise."[1]

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Although fatigue among maintenance personnel has not specifically been cited as a cause of a major accident, on several occasions, maintenance work "performed at night by staff who may have been affected by fatigue or lack of sleep" has been identified as a causal factor, ICAO said.

For example, ICAO cited a June 10, 1990, incident in which the left windshield of a British Airways BAC 1-11 blew out as the airplane was climbing through 17,300 ft after departure from Birmingham International Airport in England. The commander was drawn halfway out of the opening and held there by cabin crewmembers until the first officer landed the airplane in Southampton. Investigators said that maintenance personnel who had replaced the windshield the night before had used bolts that were not the size specified. The U.K. Air Accidents Investigation Branch (AAIB) said in its final report that several human factors issues had contributed to the incident, including "circadian effects" — biological patterns that influence the time of day when the body is programmed to sleep — on maintenance personnel.

Fatigue also contributes to non-reportable incidents, and ICAO cited the case of one unidentified operator of a fleet of 12 aircraft that experienced extensive structural damage to one aircraft because of incorrect jacking procedures, extensive structural damage to two aircraft because of a towing collision, and serious injuries to three maintenance technicians because of a traffic accident that occurred as they drove home after a

long shift at work (see "Fighting Fatigue-Related Errors," p. 17).

Studies conducted for several civil aviation authorities and accident investigation bureaus have identified fatigue as a significant problem for aviation maintenance personnel.

One study, a U.S. Federal Aviation Administration (FAA) survey of maintenance human factors programs worldwide, found that of 414 survey respondents, 82 percent said that fatigue is a safety issue in aviation maintenance. Only 36 percent said that fatigue was addressed in their training programs, however, and only 25 percent said they had a fatigue management system.[2]

"The discontinuity between recognizing the fatigue threat and establishing barriers is alarming," two of the study's authors said. (*ASW*, 3/08, p. 34–40).

Half of the 1,209 AMEs responding to questionnaires believed that overtime worked during night shifts "had a strong negative effect on their work."

Another study, conducted in 2002 for Transport Canada (TC), found that aviation maintenance engineers (AMEs) were working an average of more than 50 hours a week, often in 12-hour shifts "with very few days off for recovery." A significant number of AMEs worked during their days off, either putting in overtime or working extra shifts for another employer, the study said. In addition, the study found that half of the 1,209 AMEs responding to questionnaires believed that overtime worked during night shifts "had a strong negative effect on their work."[3]

The U.K. Civil Aviation Authority (CAA) also recognized the adverse effects of tiredness and fatigue. In an airworthiness notice discussing "personal responsibility when medically unfit," the CAA said that individual maintenance personnel "should be fully aware of the dangers of impaired performance due to these factors and of their personal responsibilities."[4]

© Chris Sorensen Photography

ICAO, citing various human factors guides, said that although individuals are responsible for "sensible" sleep habits, "management and local supervision … have a responsibility to control shifts, breaks, duty periods and overtime to minimize fatigue."

The most straightforward approach is a strict limit on the number of hours worked, said Darol V. Holsman, FSF manager of aviation safety audits. During evaluations of corporate operations, he always recommends a fatigue management policy and always says the best policy is a 12-hour duty-time limit.

"This is one of the human factors issues that should be considered by every operator," Holsman said.

Nevertheless, his estimate is that less than 10 percent of corporate operators have duty-time limits — the limit most often is 12 hours, but some operators establish 14-hour limits — or fatigue management programs. These limits have been implemented within the last three or four years, Holsman said, noting that when he began auditing in 2000, he never found a corporate operation that limited duty time for its maintenance personnel.

The reason for the low percentage is tradition, he said.

"It's always been this way," he said. "If there's work that needs doing, the expectation — of managers and the technicians themselves — is that they'll be out doing it. The technicians are sometimes their own worst enemy; they willingly do what's expected."

Often, the problem is complicated by sporadic work hours; many operators tell mechanics that when there's no flying activity, there's no reason for them to report to work. "The thinking is that if they work only a few hours one week, then the next week they should be able to work long hours if necessary," Holsman said. "But this still doesn't relieve the responsibility of management to limit duty hours."

Despite the willingness of most maintenance personnel to work long hours to meet those expectations, some also tell stories of falling asleep while working on an airplane, he said.

A few operators and regulatory authorities have rejected duty-time limits in favor of a fatigue risk management system (FRMS), designed to detect behavior related to fatigue and, by doing so, to prevent fatigue-related incidents.

Drew Dawson, director of the Centre for Sleep Research at the University of South Australia, said that FRMS requires consideration of five major levels: "sleep opportunity or average sleep obtained across the organization, actual sleep obtained by individual employees, presence of fatigue-related behavior, occurrence of fatigue-related errors and occurrence of a fatigue-related accident or incident." In an effective FRMS, all five levels are addressed with organized defense systems.[5]

In most cases, FRMS has thus far been applied only to flight crews, but a Canadian initiative aims to incorporate FRMS for both flight crews and maintenance personnel as a mandatory portion of an operator's safety management system (SMS). At press time, the FRMS notice of proposed amendments to the Canadian Aviation Regulations was being reviewed by the Department of Justice; the requirements were expected to take effect for aviation maintenance organizations (AMOs) in March 2009, said Jacqueline Booth-Bourdeau, chief of technical and national programs for TC.

"The implementation of an FRMS is an extension to this [SMS] approach in that it requires operators to implement robust management systems for identifying fatigue-related hazards and managing the related risks," Booth-Bourdeau said. "The FRMS approach clearly establishes the accountabilities at the management and employee levels for fatigue-related issues."

To aid the industry, TC developed an FRMS toolbox, a collection of policy templates, training materials and other approved methodologies for FRMS implementation. The topics covered in the toolbox's training information for employees include how to obtain sufficient rest, manage fatigue and recognize fatigue symptoms in themselves and others. Management materials discuss the implementation process and how to provide sufficient rest; investigate fatigue-related errors, incidents and accidents; and conduct FRMS audits.[6]

A planned implementation trial, using the toolbox, was canceled because of a change in management at the participating airline, Booth-Bourdeau said.

In Australia, the Civil Aviation Safety Authority (CASA) also is moving toward implementation of FRMS in aviation maintenance.

The CASA maintenance regulations project team said that, although FRMS is not mandatory for aviation maintenance personnel, "CASA is convinced that [it] is necessary and is initiating its design and formulating requirements for implementation.

"Safety outcome-based legislation being developed will place the onus on an employing organization to ensure that there are systems in place to 'preclude an employee from fulfilling any maintenance action where the employee's capability to do it is impaired.'"

The regulation will be accompanied by an Acceptable Means of Compliance,

Fighting Fatigue-Related Errors

Human factors guides recommend a variety of actions to prevent aviation maintenance errors that stem from fatigue. For example, the International Civil Aviation Organization, in its *Human Factors Guide for Aircraft Maintenance Manual*, recommends the following:

- Because tools and parts can obstruct flight controls if they are left in an aircraft after maintenance, a box or shadow board for wrenches, screwdrivers and other hand tools should bear contrasting-color outlines of each tool to provide a cue if it is not replaced;
- Hand tools that are the personal property of a maintenance technician should be marked, and checklists should be used for each technician's toolbox before an aircraft is released for return to service;
- When maintenance personnel take possession of company-owned tools, a loan system using personal "tool checks" or electronic card controls should be used to identify the person who has possession;
- "Loose-object" inspections should be conducted before final panel closures;
- To limit interruptions, people not involved with maintenance on a specific aircraft should be excluded from the area, unless they have the permission of a supervisor, and only those not working on the aircraft should answer telephone calls; and,
- To avert cross-connections of wiring or plumbing, parts should be color-coded as they are disassembled; to identify cross-connections, functional testing should be conducted any time wiring or plumbing is disturbed. Any instances of cross-connection should be reported to the regulatory body and the type certificate holder.

— LW

"which will describe how an organization may meet the requirements of the regulation, with a range of options dependent on the size of the organization and the nature of the maintenance to be conducted," the project team said. Maintenance organizations will be required to submit written plans explaining how they will comply with FRMS requirements.

The team said that CASA plans to establish a group including representatives of CASA, AMOs and employee associations to "formulate a way forward" in development of detailed FRMS policies.

Some operators and AMOs have implemented fatigue management programs — sometimes through labor agreements — even without a regulatory requirement to do so.

In Canada, for example, provincial governments limit hours for workers of all types, although they also establish provisions that allow the limits to be exceeded. In addition, some operators, usually smaller organizations, limit work hours to a single eight-hour daytime shift in what is essentially a form of FRMS, Booth-Bourdeau said.

In the United States, the National Transportation Safety Board (NTSB) has for years urged the FAA to limit work hours for maintenance personnel and others in the aviation industry "based on fatigue research, circadian rhythms, and sleep and rest requirements." A recommendation was added in 1999 to the NTSB's annual "most wanted" list of safety improvements, specifically calling for a review of fatigue in aviation maintenance and the subsequent establishment of duty time limitations "consistent with the current state of scientific knowledge for personnel who perform maintenance on air carrier aircraft."[7]

The NTSB said that it disagrees with the FAA's position that regulatory action is not appropriate, and said that Advisory Circular 120–72, *Maintenance Resource Management (MRM) Training* — characterized by the FAA as a focus of its fatigue education and training efforts for aviation maintenance personnel — in fact contains "little … guidance on human fatigue in maintenance crews other than generalized warnings that attention to fatigue is important and should be considered in MRM training."

However, the FAA has emphasized, as Deputy Associate Administrator for Aviation Safety Peggy Gilligan told a congressional subcommittee in June 2007, that fatigue research by the FAA and others has shown that fatigue "does not easily lend itself to a set of prescriptive rules." As a result, she said that, in the future, fatigue risk management will become increasingly important.[8]

The FAA and other proponents of FRMS say that rules to limit work hours are not enough to combat fatigue.

The University of South Australia's Dawson said that, increasingly, sleep specialists believe that traditional duty-time limits "may not be the most appropriate or only way to manage fatigue-related risk."[9]

"The assumption is that compliance with the limits on working hours is evidence that an individual is adequately rested and fit for work and will not make any fatigue-related errors," Dawson said. Nevertheless, "any hazard has multiple causes and should thus be managed using multiple overlapping defenses." ●

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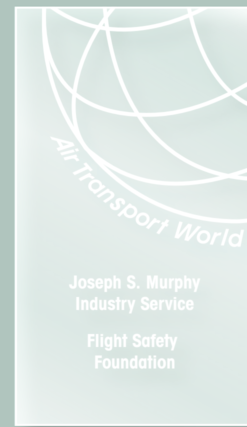
Honored in SINGAPORE



Flight Safety Foundation, in a ceremony in Singapore, was presented the Joseph S. Murphy Industry Service Award by *Air Transport World (ATW)*, the airline management magazine. The award is named in honor of the magazine's founder.

"Tonight we honor an organization that has ensured that aviation safety is at the forefront around the world," said *ATW* Senior Editor Aaron Karp. "For 60 years, the not-for-profit Flight Safety Foundation has served as an independent voice unconstrained by geography or industry boundaries, providing the global aviation business with a neutral forum to discuss and learn best practices and find solutions to problems with only one goal: reducing the risk of accidents.

"*ATW* salutes the Foundation not just for its laudable and lengthy list of past achievements but also for its ongoing and future effort to bring awareness to serious safety issues around the globe."

William R. Voss, FSF president and CEO, accepted the award, saying, "We all have a lot to celebrate today. We have an industry that has achieved extraordinary levels of safety around the world. And I have to say that it is quite an honor to have the contributions of FSF recognized here today. But I have to share that honor with 1,200 members of the Foundation that make that work possible, including many of you in the room here today."

Voss discussed several FSF initiatives. "First of all, a new and sort of activist role for us. We have great victories in aviation safety, but the victories aren't universal. There are places around the world that are still struggling to do well. I spend a lot of time working with those people. And everywhere I go, I find heroes, I find people who know exactly what needs to be done, people who will do anything to try to achieve further improvements in safety. But they are challenged. Often they are not allowed to do what they know is necessary due to problems of political will or resources, even commercial constraints. So there's one thing we all have to do as an industry, and one thing you'll see us do at the Foundation, and that is to go to bat for these people to make sure they get the opportunity and the support they need to do what they know needs to be done."

Turning to the growing shortage of trained personnel, Voss said, "Something very important for us as a Foundation is to have a consciousness, an awareness paying attention to the system, so that if at some point we go beyond what is possible — we start overreaching — we'll have early warning systems that go off, indicators that say, 'it's time to pull back to make sure we maintain the level of safety we've achieved over these decades.'" ●


J.A. Donoghue

Flight Safety Foundation President and CEO William R. Voss (right) accepts the Foundation's award from *Air Transport World* Senior Editor Aaron Karp.

Novelty marked the 2008 air show in the heart of aviation's high-growth region

SINGAPORE'S NEW SHOW

BY J.A. DONOGHUE

The new exhibit hall's proximity to the static display area (bottom) was one of many improvements. Stratech's iFerret runway foreign object surveillance system (below) was ordered for Singapore's Changi Airport.

Questions about whether the new Singapore Airshow site, organizers and business climate would measure up to the standards set by the previous and now-departed "Asian Aerospace" show generally received positive responses from visitors to the 2008 event.

The newly constructed show facility and roads, set on reclaimed land developed on the eastern side of the island city-state, were vastly superior to the old site. Plenty of exhibit space, adjacent aircraft display areas, air conditioning that worked and well-planned roads made the physical act of attending and exhibiting much less arduous than before. The new organizers' efforts took care of most new-show kinks, as well.

However, coming on the heels of record orders booked last year at the Paris and Dubai air shows, the Singapore show was unlikely to compare well. While exhibitors announced US$13 billion in sales of new aircraft, engine and support equipment, a number that would have been seen as fairly healthy in past years, that figure paled in comparison with the $100 billion and $75 billion logged at Paris and Dubai. However, the fact that many production lines are sold out so many years into the future made significant additional orders unlikely. Nonetheless, Lion Air stood out with its $4.4 billion order for 56 more Boeing 737-900ERs, elevating its order book for that type to 178 airplanes.

There was a decided lack of airliners at the show. Just the Airbus A380 appeared at the show, and it flew. The rest of the flying during the show's one-hour daily flying window was done by military solo and team efforts. However, corporate aviation was well represented in the static displays, as manufacturers didn't miss an opportunity to display in one of the fastest growing corporate aviation markets in the world.

Singapore also is where many international aerospace manufacturing and service companies are establishing or expanding their Asia/Pacific facilities, taking advantage of the national government's drive to expand aerospace in Singapore. During the show there were nine ceremonies marking facility groundbreakings, expansions or openings.

Lufthansa Technical Training joined the trend, opening a new training center at Temasek Polytechnic, joining other facilities in Tianjin, China, Haikou, China and Manila, Philippines. The demand for training in the region is skyrocketing due to aviation's growth, but that growth "is making it very difficult to hold onto" the trained people, said Ralph Kaeding, general manger of the training center. "When the more prosperous regions have a [personnel] need they take out the wallet and say, 'I need the people, what is the cost?'"

Kaeding told *ASW* there are cultural differences in the employee turnover problem: "Certain nationalities stay at a job for life." In other places, including the Philippines, Singapore and Indonesia, turnover "is difficult."

Despite new training facilities opening all the time in the Asia/Pacific region, "in some places with big growth they're not prepared for this." The Singapore maintenance, repair and overhaul cluster alone requires 1,000 newly trained people annually, Kaeding said.

The flying was closed each day by the Royal Australian Air Force Roulettes demonstration team flying Pilatus PC-9s.

Keith Tan, vice president and general manager of Goodrich Aerostructures Service Center—Asia in Singapore, said that even with the nation's system of polytechnic schools, "we need to do our own specialized training" to feed a Goodrich presence that has grown from 14 to 700 people in 10 years. The company, however, does not have a major turnover problem, he said, possibly because it sits at the top of the food chain. "Due to our people philosophy and a good incentive plan, very few people leave us. It's all about how you treat your people, and we have a good reputation."

Among the safety advances highlighted at the show was the first order for Stratech's iFerret runway surveillance system that uses a line of cameras to visually inspect the runway, preventing foreign object damage. After a 15-month trial at Singapore's Changi Airport, the system was ordered by the Civil Aviation Authority of Singapore to monitor Changi's two main runways. The iFerret system uses artificial intelligence to detect a new foreign object on the runway, alert operators and zoom for close inspection. An evaluation by the U.S. Federal Aviation Administration (FAA) is to be conducted starting this spring at Chicago O'Hare Airport, Stratech officials said.

Gulfstream announced its new Flight Operations Risk Management Service that will enable operators to conduct flight data monitoring programs, also known as flight operations quality assurance (FOQA), on all of its in-production aircraft, plus several aircraft no longer in production. While the Gulfstream program can supply full analysis services, using Austin Digital for that function, the system can support any FOQA program, a company official said.

Honeywell's Integrated Primary Flight Display (IPFD) received its technical standard order approval from FAA the day before the show opened. The IPFD utilizes "digitized data base of worldwide terrain and obstacles to provide pilots a synthetic '3-dimensional, real-time, out the window' representation of terrain and obstacles on an aircraft's primary displays," the company said. The system integrates existing flight deck information with head up display advanced symbology, generated from the enhanced ground proximity warning system terrain database and graphics generators. ●

The growth of corporate aviation in the Asia/Pacific area attracted business aircraft (above). Airbus delivered its second A380 to Singapore Airlines days before its demonstration aircraft flew at the show (bottom).

All photos: J.A. Donoghue

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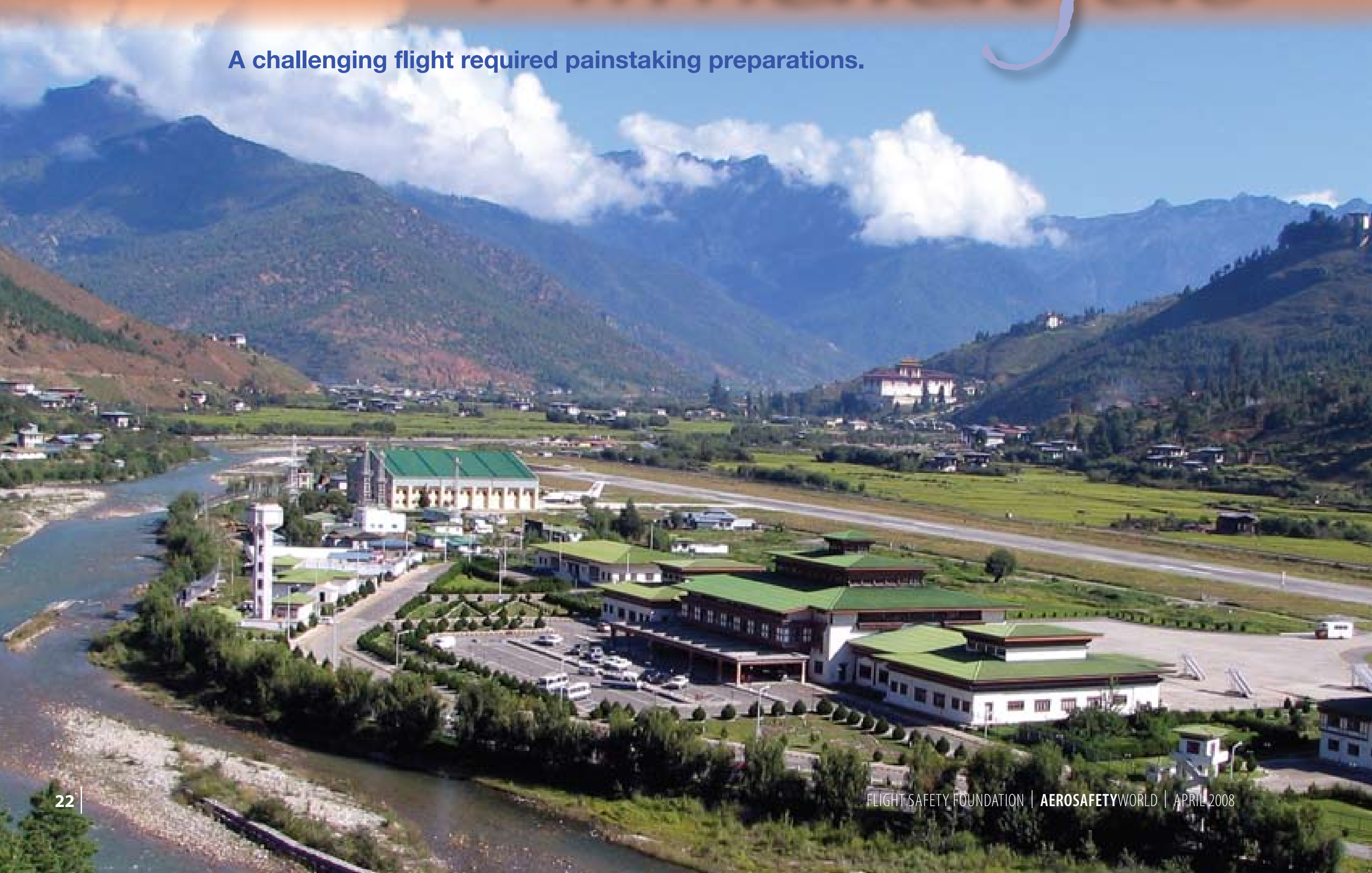
VFR in the Himalayas

BY PATRICK CHILES

A challenging flight required painstaking preparations.

Early in 2007, our company was approached about conducting an around-the-world flight that promised to be a real logistics challenge. The itinerary and time frame were daunting, but one location in particular gave us pause. Our customer needed to fly into Paro, in the Kingdom of Bhutan.

To say we were unfamiliar with the place would be an understatement — most of us had never heard of it. We knew Tibet, had even worked trips to Nepal, but never to the small, isolated country nestled between them. Our initial look at the airport was not encouraging. At an elevation of 7,300 ft, the airport is tucked ino a deep valley, flanked by 18,000-ft mountains. The only instrument approach was a very-high-minimums "cloud-break" procedure that did not even serve our approach category. One portion of the chart was filled with the type of terrain contours that immediately give one pause, but an equally large portion of the chart was blank and marked "Relief Data Incomplete." As far as we were concerned, it may as well have read "Here Be Dragons." Internet searches yielded photos of the airport environment that did not offer much encouragement.



At an elevation of 7,300 ft, the airport is tucked into a deep valley, flanked by 18,000-ft mountains.

© Md. Aminul Hassan/Wikimedia

As our research progressed, we were fortunate to find an article in a 2003 issue of Boeing's *Aero* magazine describing technical demonstrations at Paro of a BBJ, the same type aircraft that we operate. The demos actually were flown in an aircraft that had originally been destined for our company. So, with photographic evidence of a BBJ in NetJets livery taking off from that very airport, with a majestic Himalayan valley in the background, how could we say no?

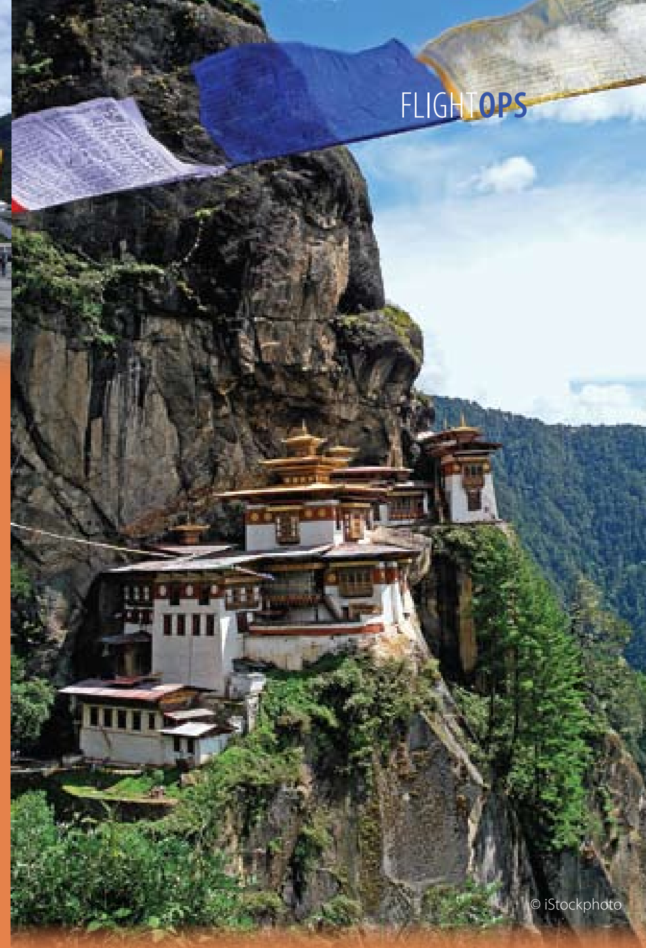
Not Been There, Done That

Of course, things are never that simple. A picture is no guarantee of success. The demo flights were conducted under the general operating and flight rules of U.S. Federal Aviation Regulations Part 91 — though their obstacle analysis went far beyond anything strictly required for Part 91. The procedures were validated by Boeing engineers and flown by their test pilots. Our company, on the other hand, would have to run this operation as a Part 135 charter, requiring rigorous procedure development and pilot training.

We first looked for the "low-hanging fruit" and investigated potential required navigation performance (RNP) procedures, such as those recently developed by China for Linzhi, one of Tibet's most inaccessible airports. As a matter of fact, the final approach to one of the runways in Paro looked remarkably similar to Linzhi. However, no such procedures existed — Paro is a daytime-only, visual flight rules (VFR) airport. There certainly would not be enough time to create and certify a new RNP approach — the trip was two months away.

So, our planning had to be based on the simple fact that the flight would have to arrive and depart in visual conditions.

VFR operations meant that we would have to carefully analyze our approach and departure paths, and set appropriate minimums. We obtained detailed topographic maps created by the



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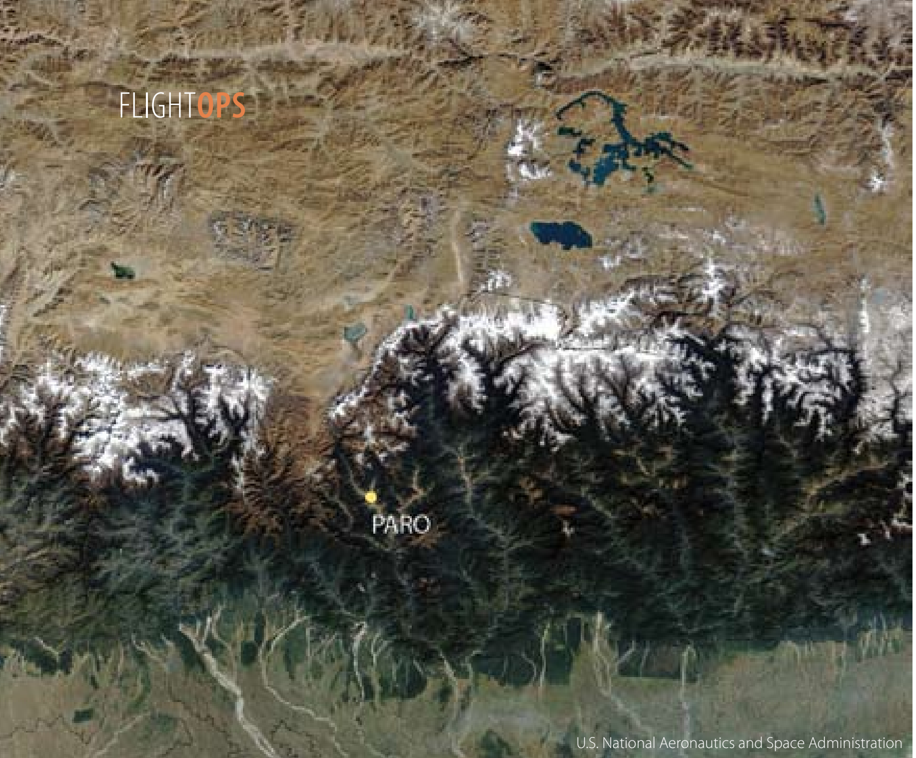
former Soviet Union and terrain data from the U.S. National Aeronautics and Space Administration space shuttle radar topography mission (SRTM). The SRTM data proved to be an excellent source, with resolution down to 90 m (295 ft).

Initial attempts to develop an engine-out departure path focused on attempting a steady climb out of the valley with a minimum of turns. Our goal was to limit turns to a maximum of 15 degrees of bank. This led to a creative solution that clearly would not work, because it ultimately would have required a blind 180-degree turn around a 12,000-ft ridge, with no way to know what type of weather was coming up the valley on the other side of the ridge.

United Nations/Susan Reed

© Douglas J. McLaughlin/Wikimedia



U.S. National Aeronautics and Space Administration

In a locale of Shangri-La proportions, Paro lies deep within the Himalayas.

This led us to have another look at the existing procedures. These departure paths were based on turns inside the valley walls at 25- and 30-degree banks, which we had hoped to avoid. But given the terrain and our engine-out climb capability, there was no alternative but to plan for turns inside the valley. We determined right away that it would be wise to use a greater allowance for lateral terrain separation than the regulatory 300 ft/90 m (*ASW*, 7/07, p. 26). The procedures we had seen had used a 500-ft/150-m margin, and that seemed a fine place to start.

As it turned out, there wasn't much room for breaking new ground in procedure design.

Terrain Dictates Flight Path

Planning for the flight out of Paro gave us our expected takeoff weight, which we used to make an early determination of V-speeds. This defined our climb capability and turn performance, so procedure development became an iterative process: fit the curves defined by weight and speed within the valley at the appropriate heights, with a 500-ft margin. The valley walls would define the path our flight crew would have to follow in the event of an engine failure before V_1 and a decision to continue the takeoff. Although we endeavored to not copy those who had gone before us, in the end the procedures were almost identical. The terrain is what it is — there was little margin for individual preference.

Previous experience in designing area navigation (RNAV) procedures at Eagle Regional Airport, high in the Colorado Rocky Mountains, prompted us to hire an outside vendor to assist in terrain evaluation and procedure design. ASRC Research and Technology Solutions' assistance and insight proved invaluable in validating our procedures. They were able to acquire the old Red Army topographic charts and applied three-dimensional stereo-imaging of overhead photos to confirm the charted contours and evaluate both man-made obstacles and naturally occurring obstacles, such as trees.

We made it a point early in our relationship to avoid leading the vendor to any one preferred conclusion. ASRC's analysis came to the same independent conclusion about the takeoff paths from Paro's single 7,332-ft (2,235-m) runway. This was also good for our comfort level; now we had three different analyses — Boeing's, ASRC's and our own — that arrived at nearly identical solutions.

Eyes in the Sky

While our chief pilot, Rick Weeks, and I worked on procedure design with ASRC, our director of safety and standards, Mark Atterbury, established contact with Bhutan's state airline, Druk Air. Their chief pilot, Dhondup Gyaltshen, was invaluable to our success. To obtain a landing permit at Paro, any private aircraft operator must train its pilots in a flight simulator that has a visual model of Paro or have one of Druk Air's pilots in the observer's seat during actual operations at the airport.

We elected to do both. Atterbury, who would serve as pilot-in-command during the trip, received training in a BAe 146 flight simulator at the BAE Systems, now Oxford Aviation Academy, facility in Manchester, England. The facility has one of only two visual simulator models of Paro; the other model is at the Airbus facility in Beijing.

Atterbury also flew to Paro as a cockpit observer in a Druk Air A319. While on the ground in Bhutan, he drove up the valleys from each end of the runway to identify landmarks he had seen from the air.

Flying the simulator, observing from the cockpit and arranging to have an experienced

©Jon Larson/iStockphoto

Music by Iron Maiden
FOQA by Flight Data Services

> **We use FDS because of their ability to analyze events without large amounts of data.**
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You probably associate the name Bruce Dickinson more with rock band Iron Maiden than with flight safety. In reality Bruce is just as happy piloting an aircraft as he is belting out heavy metal numbers and frequently takes the controls when flying from gig to gig on their latest world tour.

The Boeing 757 used for the world tour was converted by, and is leased from, Astraeus who use Flight Data Services (FDS) to monitor and manage their flight data.

Quite often VIP operators have fewer flights to analyze and erratic patterns of operations. Safety monitoring techniques that rely upon building statistically meaningful results, or worse still, that wait for a trend in data, will fail to identify problems with a particular airport from a single aircraft.

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safety pilot in the jump seat gave everyone a high level of confidence that we could accomplish this trip safely and on our customer's demanding schedule. The simulator training alone would have been adequate for practicing the engine-out turns, but the safety pilot was crucial for getting there in the first place, because descending into the wrong valley reportedly was easy to do and could have disastrous consequences.

The visit to Paro provided a surprising revelation, which pointed out the limits of our comparatively academic exercise with the turn procedures. Despite the care we had taken to evaluate topography, our conclusions about the safest direction for takeoff were literally turned 180 degrees. Our analysis had led us to believe that departing on Runway 15 would be preferable, but the opposite was true, according to Atterbury's flight to Paro and look-around from ground level.

As he put it, "Runway 33 was the obvious choice since you could see the entire maneuvering area from the airfield, and it provided enough clearance to continue climbing while circling in the valley, if need be. Runway 15 could have you flying into weather not visible from the ground and then rely on the terrain mapping to stay out of the 'cumulogranite' buildups."

Back to the Drawing Board

A departure from Runway 33 would require immediate turns as soon as the aircraft reached the regulatory minimum of 50 ft above ground level (AGL). The most challenging turn would require a 30-degree bank to reverse course within the valley, back toward the airport, for a 228-degree heading change. We determined that keeping a maximum V_2 of 140 kt true would produce a turn radius adequate to maintain 500 ft of lateral separation and keep the deck angles within a reasonable value — this would allow the crew to visually avoid the terrain. This speed limit included a 10-kt margin for improved climb performance and stall protection in the steeper bank, recalling that the V_2 values in the aircraft flight manual provide stall protection for turns with 15 degrees of bank. Besides needing a higher speed for stall margin, the improved climb benefit was needed to ensure that the aircraft would clear a ridge at the end of the turn.

Once the required true airspeed for a given weight and flap setting is established, turn radius becomes a function of bank angle, regardless of the aircraft — a specific model's aerodynamics are relevant only to the loss of climb gradient within the turn.

This led to an interesting conclusion that fell outside the well-known takeoff performance limitations: field length, tire speed, brake energy, climb and obstacles. While obstacles and climb gradient were certainly driving forces, the takeoff effectively would be limited by turn radius and airspeed. Due to the turn clearance, it was critical to keep V_2 as close as possible to the established speed limit without exceeding it. That, in turn, drove the weight down to a hard limit to ensure the 140-kt "magic number."

This would allow us only about an hour's worth of trip fuel, not counting reserves. One factor that worked in our favor was that the Boeing demo flights had been performed at a thrust rating of 26,000 lb (11,794 kg) to emulate a standard-issue 737-700. The BBJs are rated to 27,300 lb (12,383 kg) thrust, which improved our weight off the runway over that of the demonstrator.

Limited Alternates

Other mitigating factors worked to narrow our window of opportunity. The weight-limited range would, of course, reduce our choices of destinations and alternates. There are few airports within range that could be used for either. If the weather went below minimums at these airports, the flight would be stuck in Paro until the weather improved. In addition, very high minimums had to be set for the visual arrival and departure. Finally, this trip would be operated just prior to Bhutan's monsoon season. Temperatures would be getting warmer, and winds in the valley are such that it is common practice to cease operations after 1000 local time even though the airport technically is open until sunset.

Because of this, we found it useful to gather all the historic climatology data that were available, and we contracted special forecasting services through our international handler, Jeppesen. We also used this information to evaluate the effects of unanticipated winds aloft on turn radius and climb distance.

Armed with this information, the simulator training and the site visit, the flight crew was able to safely make this challenging trip happen on schedule. Several other individuals and entities helped our success, particularly the authorities and airline employees at Paro. Only within the last few years has Bhutan been opened to expanded tourism. It is by all accounts a beautiful locale of "Shangri-La" proportions. We have since had more requests for trips, as have other BBJ operators I have met, and our European division has flown there twice this year.

Paro is certainly an excellent candidate for RNP procedure development. Until that happens, our experiences are presented here to the aviation safety community in the hopes of encouraging thorough training and rigorous analysis.●

Patrick Chiles is technical operations manager for the NetJets Large Aircraft (BBJ) program and a member of the FSF Corporate Advisory Committee.

Tell us who deserves an award for advancing aviation safety.

Call for Nominations

The Flight Safety Foundation annual safety awards recognize outstanding individual and group achievements. Recipients of these prestigious awards, nominated by aviation professionals and organizations worldwide, are selected by independent boards.

The following awards are being presented at Honeywell's Press Dinner at the Farnborough International Airshow, July 12, 2008:

The Honeywell *Bendix Trophy* for Aviation Safety was re-established in 1998 by AlliedSignal (which later merged with Honeywell) to recognize contributions to aerospace safety by individuals or institutions through innovation in advanced safety equipment and equipment utilization.

The nominating deadline is April 21, 2008.

The *Aviation Week & Space Technology* Distinguished Service Award — the oldest of the Foundation's awards — has been sponsored since 1949 by *Aviation Week & Space Technology* and is administered by the Foundation.

The award is presented for "distinguished service in achieving safer utilization of aircraft." It was the brainchild of Jerry Lederer, the founder of Flight Safety Foundation and a pioneer in aviation safety.

The nominating deadline is April 21, 2008.

The following awards will be presented at the 61st International Air Safety Seminar in Honolulu, Hawaii, October 27–30, 2008:

The Flight Safety Foundation–Boeing Aviation Safety Lifetime Achievement Award recognizes an individual for his or her lifetime commitment and contribution to enhancing aviation safety.

Nominees should have devoted efforts spanning two decades or more to enhance civil aviation safety and/or military aviation safety beyond the normal expectations of their particular job assignments. Nominations can be posthumous.

The nominating deadline is May 9, 2008.

The Laura Taber Barbour Air Safety Award recognizes notable achievement in the field of aviation safety — civil or military — in method, design, invention, study or other improvement. The award's recipient is selected for a "significant individual or group effort contributing to improving aviation safety, with emphasis on original contributions," and a "significant individual or group effort performed above and beyond normal responsibilities."

The nominating deadline is May 9, 2008.

Presented since 1966, the **Admiral Luis de Florez Flight Safety Award** recognizes "outstanding individual contributions to aviation safety, through basic design, device or practice."

A retired U.S. Navy admiral and a Foundation president in the mid-1950s, de Florez was influential in the development of early flight simulators. He received the 1943 Collier Trophy — one of the most prestigious awards for aeronautical achievement in the United States — for his work in training combat pilots and flight crews.

The nominating deadline is May 9, 2008.

The Cecil A. Brownlow Publications Award was first presented in 1968 and renamed in 1988 in memory of Cecil A. Brownlow, the FSF editor of publications from 1981 until shortly before his death in 1988.

The award recognizes significant contributions by journalists to aviation safety awareness. Candidates may be individuals, publications or organizations. Nominations may be for long-term achievement or for outstanding articles, books or works in electronic media published or broadcast between July 1, 2007 and June 30, 2008.

The nominating deadline is July 31, 2008.

For complete award criteria, information about past recipients and online nomination forms, please visit the FSF Web site <www.flightsafety.org/awards.html>.

FIRE in the HOLD

The DC-8 flight crew received little warning of the impending conflagration.

BY MARK LACAGNINA

Philadelphia Fire Department

Twenty-five minutes after the flight crew detected a faint odor like burning wood, their 40-year-old freighter was doomed by a raging cargo fire. On final approach to Philadelphia International Airport near midnight Feb. 7, 2006, the crew of the McDonnell Douglas DC-8-71F was running out of time. There was little, if any, prospect of a successful go-around.

"They didn't have minutes. This flight was seconds from disaster," said Deborah Hersman, a member of the U.S. National Transportation Safety Board (NTSB), during the board's public meeting on the accident in December 2007.

Billowing smoke blinded the three crewmembers soon after they brought the airplane to a stop on the runway. They escaped with minor injuries from smoke inhalation. The DC-8 was a total loss, and most of the cargo aboard the airplane was destroyed or damaged by the fire. In its final report, NTSB blamed the fire for the accident but said that the ignition source could not be determined "due to the destruction of potentially helpful evidence."

"Contributing to the loss of the aircraft were the inadequate certification test requirements for smoke- and fire-detection systems, and the lack of an on-board fire-suppression system," the report said.

The DC-8, operated as Flight 1307 by United Parcel Service (UPS), was inbound to Philadelphia from Atlanta. The flight crew were working the second day of a five-day sequence. They had flown the DC-8 from Atlanta to Philadelphia and back to Atlanta the night before the accident.

The captain, 59, had about 25,000 flight hours, including 16,000 flight hours as a DC-8 pilot-in-command. He was hired by UPS in 1988. The first officer, 40, had 7,500 flight hours, including 2,100 hours as a DC-8 second-in-command. He joined UPS in 1996. The flight engineer, 61, had 9,000 flight hours, including 430 flight hours as a DC-8 flight engineer. He was employed by UPS in 1994.

The captain and the first officer told investigators that they had difficulty transitioning from their daytime off-duty schedules to their nighttime work schedules. The captain had slept about six hours the morning of the accident flight. The first officer said that he had slept about two hours that morning and "napped for a few hours in the afternoon." The flight engineer said that he had followed his normal layover routine, sleeping about five hours in the morning and napping for about two hours in the evening, and that he felt rested for the flight. The report said, however, that there was no evidence that the flight crew's performance was degraded by fatigue.

'Smells Like Wood Burning'

Nighttime visual meteorological conditions prevailed when the DC-8 departed from Atlanta at 2241 local time. The first officer was the pilot flying. The crew said that the flight was uneventful until they began the descent from cruise altitude — Flight Level (FL) 330 (about 33,000 ft) — about 157 nm (291 km) southwest of Philadelphia. The airplane was descending through FL 310 at 2334 when the first officer said, "Smells like wood burning. Smell that?"

"I smelled it for a couple of seconds," the flight engineer said.

"It's pretty strong now," the first officer said.

The flight engineer vacated his seat and pulled open the left side of the smoke curtain, a ventilation barrier that covers the netting between the galley and the main (upper) cargo compartment. The compartment holds 18 cargo containers and is not accessible after the cargo containers are loaded. A smoldering fire had begun inside a container near the back of the compartment.

The flight engineer used a flashlight to inspect the left wall of the compartment. "He stated that he could smell the odor but that he did not see any smoke or fire," the report said.

The captain considered diverting the flight to a nearby airport but decided to continue to Philadelphia. The report said that this decision was "not inappropriate," considering the circumstances: There was no visible smoke, and no annunciator lights had illuminated to warn of smoke or fire in a cargo compartment. "Further, the flight crew stated that unusual odors could be common from nonthreatening factors, such as flying over forest fires or unusual cargo," the report said.

McDonnell Douglas DC-8-71F

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Douglas Aircraft Co. began production of the DC-8, its first jet transport, in 1959. The first five versions of the DC-8 have the same overall dimensions. In 1965, a stretched version, the DC-8-61, was introduced. Douglas merged with McDonnell Aircraft Corp. in 1968.

In 1981, the DC-8-61's four Pratt & Whitney JT3D engines were replaced with CFM International CFM56s; the re-engined airplane is called the DC-8-71. The -71F is the freighter version and has an upward-hinged cargo door on the left side of the forward fuselage. Cargo capacity is 8,810 cubic ft (247 cubic m). Maximum landing weight is 258,000 lb (117,029 kg).

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

Inappropriate Checklists

There were no specific procedures in the aircraft operating manual (AOM) for responding to an unusual odor in the absence of a warning light. The AOM contained four checklists that dealt with smoke, fire or fumes, but none was appropriate for the situation, the report said. The checklists were titled "Fire," "Fumes Evacuation," "Lower and/or Main Cargo Compartment Smoke" and "Pack Smoke."

The DC-8 was about 65 nm (120 km) from Philadelphia, descending through FL 180, at 2343, when the flight engineer announced that he had set the air-conditioning packs to maximum flow and had turned off the recirculation fan. The report said that these actions, performed in accordance with the "Fumes Evacuation" checklist, exacerbated the situation by increasing airflow in the cargo compartment. The increased airflow diluted the smoke, inhibiting its detection, and provided additional oxygen to the fire.

The AOM did not specify when the "Fumes Evacuation" checklist should be used, the report said, noting that the checklist is appropriate when fumes "cause irritation or otherwise prevent the flight crew's ability to operate the airplane."

The report discussed an international project sponsored in 2004 by Flight Safety Foundation to improve guidance for air carrier pilots in responding to nonalerted smoke/fire/fumes events. Project participants developed the *Smoke/Fire/Fumes Checklist Template*, as well as directions for completing the checklist with information provided by the airplane manufacturer and guidance on using the checklist in conjunction with other checklists in the AOM (*Flight Safety Digest*, 6/05, p. 31).

"The initial steps of the proposed checklist consist of a series of simple, rapid actions to address the most likely sources of fire," the report said. "The guidelines state that these actions should require no decision making by the flight crew, be airplane-specific and be determined by the manufacturer based on event history for each specific model airplane.

"According to the proposed checklist guidelines, unless clear visual evidence exists that all fire hazards are resolved after the initial steps, the flight crew should initiate a diversion and … not delay landing to continue the checklist for additional source identification and/or source isolation or elimination."

Boeing, which merged with McDonnell Douglas in 1997, is using the checklist template to develop new procedures related to nonalerted smoke, fire and fumes, the report said. The checklists will be available for most current models but not for older models such as the 707, 727, DC-8, DC-9 and DC-10. The report said that operators of these models will have to work with the manufacturer and the U.S. Federal Aviation Administration (FAA) to develop their own checklists for the airplanes.

In one of the many recommendations generated by its investigation of the DC-8 accident, NTSB called on the FAA to provide "clear guidance to operators of passenger and cargo aircraft … on flight crew procedures for responding to evidence of a fire in the absence of a cockpit alert based on the guidance developed by the 2004 smoke, fire and fumes industry initiative."

Runway Change

At 2346, a Philadelphia approach controller told the crew to fly a heading of 050 degrees, to sequence the DC-8 for landing on Runway 27R. Reported weather conditions at the airport included surface winds from 270 degrees at 7 kt, 10 mi visibility, clear skies and a temperature of 0 degrees C (32 degrees F).

The airplane was descending through about 15,000 ft at 2347, when the captain asked the flight engineer if he could still smell the odor. "Yeah," the flight engineer replied. "Smells like it was more to the back there."

"Smells like cardboard burning, doesn't it?" said the first officer. "You didn't see smoke, though, something like that?"

The flight engineer again searched the cargo compartment with his flashlight and said that the odor was "definitely stronger in the back" but that there "does not appear to be any smoke or haze."

The airplane was descending through 3,600 ft at 2354, when the flight engineer announced that the "CARGO SMOKE" light had illuminated. The first officer announced that he was turning the airplane directly toward the airport. The captain then told the approach controller that they had the airport in sight. The controller cleared the crew to conduct a visual approach to Runway 27R and to establish radio communication with the airport tower controller.

The tower controller said that the winds were from 260 degrees at 6 kt and cleared the crew to land on Runway 27R. "Cleared to land," the captain replied. "And, uh, listen, we just got a cargo smoke indicator come on. Can we have the equipment meet us?" The controller activated the aircraft rescue and fire fighting (ARFF) alarm and told the captain that emergency response equipment would meet the airplane on landing.

Sounds recorded by the cockpit voice recorder (CVR) indicated that the first officer and the flight engineer donned their oxygen masks. Soon after the first officer called for landing gear extension and the "Landing" checklist at 2355, the flight engineer announced that the "LOWER CARGO FIRE" light had illuminated, warning of smoke/fire in the lower cargo area, which comprises four cargo compartments.

"Oxygen masks on if you don't have them," the captain said. "And run through that checklist by yourself, OK?" The flight engineer verbalized his actions while conducting the "Lower and/or Main Cargo Compartment Smoke or Fire" checklist.

At 2356, the tower controller cleared the crew to land on the parallel runway, 27L, which is designated by the airport emergency plan for use in emergencies. "UPS thirteen oh seven heavy is cleared to land runway two seven left," the controller said. "The wind is two six zero at six." The controller did not, and was not required to specify that the landing runway assignment had been changed. The CVR recording indicated that the captain had his oxygen mask on when he acknowledged the clearance to land on Runway 27L; he said nothing about the change in runway assignment, however.

'Have to Do an Evacuation'

The "Lower and/or Main Cargo Compartment Smoke or Fire" checklist required the flight

"We just got a cargo smoke indicator come on. Can we have the equipment meet us?"

Philadelphia Fire Department

engineer to vacate his seat so that he could open an access panel on the wall behind the cockpit bulkhead and close the cargo air valve. Black smoke billowed out when he opened the access panel. After closing the cargo air valve, he announced that he had seen smoke. "We're going to have to do an evacuation, OK?" he said. "Tell them we are going to have to do an evacuation when we get down."

The captain and first officer were finishing the "Landing" checklist at 2358, when the tower controller asked the crew to confirm that they were landing on Runway 27L. "It appears you are lined up for the right," the controller said.

"I'm sorry," the captain replied. "I thought we were cleared for the right. Are we cleared to land on the right?"

"You are cleared to land on the right," the controller said. "We will just tell fire [i.e., ARFF personnel]."

"The change in landing runways — from 27L to 27R — resulted in a subsequent change in standby positions," the report said. "ARFF personnel reported that the change in runways resulted in a 60- to 90-second delay in responding to the accident scene. Seven [airport] ARFF vehicles responded."

The DC-8 touched down on Runway 27R at 2359. "Immediately after touchdown, the flight engineer reported smoke in the cockpit," the report said. "After the airplane came to a stop [on the runway], the first officer called for an emergency evacuation, and the captain and first officer conducted the 'Emergency Evacuation' checklist." The smoke had become so dense that the pilots could not see each other.

The smoke had become so dense that the pilots could not see each other.

U.S. National Transportation Safety Board

"The first officer stated that, after he transmitted to the [tower controller] that they were evacuating the airplane, the smoke was so heavy that he could not see his hand in front of him," the report said.

Both the captain and the first officer attempted to retrieve the "Notice to Captain" (NOTOC), a document that contains information about the locations and types of hazardous material being shipped aboard the airplane; however, they were unable to find it. During the flight, the NOTOC had fallen from its storage area behind the captain's seat, and the flight engineer had placed it on a bulkhead at his station.

The flight engineer took a breath of oxygen from his mask before leaving his station to deploy the emergency slide for the left forward door. All three crewmembers used the slide to evacuate the airplane.

The captain told ARFF personnel that there were hazardous materials aboard the airplane and that he had not been able to locate the NOTOC. The three flight crewmembers then were transported to a local hospital and treated for smoke inhalation.

A firefighter located the NOTOC about 35 minutes after ARFF personnel began fighting the fire with water and aqueous film-forming foam. "The first fuselage burn-through occurred about 0200 and was located in the crown of the fuselage aft of the wings," the report said. "The fire was characterized as being 'fully involved' around 0220. ARFF personnel reported that the fire was under control about 0407."

Twenty-Minute Delay

The DC-8 model originally was certified to the transport category airplane airworthiness standards of U.S. Civil Aviation Regulations 4b, which was recodified as Federal Aviation Regulations Part 25 in 1965. The accident airplane was manufactured in 1967 and purchased by UPS in 1985. It had accumulated about 67,675 flight hours when the accident occurred.

Examination of the airplane's smoke-detection system revealed no anomalies. There are seven smoke detectors on the ceiling of the main cargo compartment and 19 in the lower compartment.

Investigators determined that the fire likely began inside cargo container 12, 13 or 14

(Figure 1). Among the items that had been shipped in these containers were electronic devices, including laptop computers, with rechargeable lithium batteries. Several lithium batteries of the same type also were found loose in the accident debris.

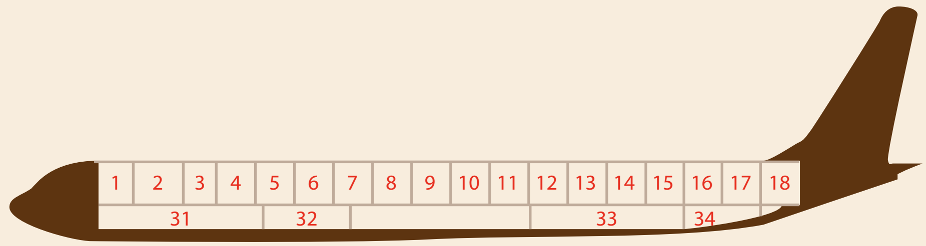
Noting that "testing and incident data indicate that lithium batteries can pose a fire hazard," the report said there was no evidence that lithium batteries were the source of ignition aboard the DC-8.

"A review of FAA and CPSC [Consumer Product Safety Commission] records shows that the number of … lithium-battery-related incidents — many of which involved laptop computer fires that resulted from either internal or external short-circuiting of [rechargeable] lithium batteries — has increased consistently over the years," the report said. The accident investigation generated several recommendations designed to prevent such incidents (*ASW*, 3/08, p. 42).

Investigators determined that the smoke-detection system aboard the DC-8 did not perform according to applicable certification standards, which require an "acceptable indication to the crew" no more than five minutes after smoke is initiated in a cargo compartment. The flight crew received the first smoke warning 20 minutes after the first officer detected an unusual odor related to the fire.

During the original certification tests of the DC-8's smoke-detection system, detection times varied from 12 seconds to three minutes, which were well within the existing standard. The report noted, however, that the certification tests were conducted in empty cargo compartments. This was done because the smoke would disperse in the open area, requiring greater sensitivity by the detection system. However, this method does not account for the effects of loaded cargo containers on smoke detection, the report said.

DC-8 Cargo Configuration



Note: The numbers 1 through 18 designate cargo container locations in the main cargo compartment. The numbers 31 through 34 designate lower cargo compartments.

Source: U.S. National Transportation Safety Board

Figure 1

"With cargo containers loaded in the cargo compartment, air exiting the air-conditioning vents in the ceiling is primarily directed outward and downward toward the floor [i.e., away from the smoke detectors]," the report said. "The cargo containers also create a barrier that the smoke must traverse before it enters the open space of the cargo compartment, where it can be detected by the smoke-detection system."

Current transport airplane certification standards require a crew alert within one minute of smoke generation. Nevertheless, certification tests of smoke- and fire-detecting systems still are typically conducted in empty cargo compartments, the report said.

Based on these findings, NTSB recommended that the FAA "ensure that the performance requirements for smoke- and fire-detection systems on cargo airplanes account for the effects of cargo containers on airflow around the detection sensors and on the containment of smoke from a fire inside a container."

Freighter Fire Hazards

The report noted that NTSB over the past 20 years has made several recommendations to require fire-suppression systems in air carrier cargo compartments. Following the May 11, 1996, cargo-fire-related crash of the ValuJet Airlines DC-9 in Florida (*Accident Prevention*, 11/97), the FAA issued a regulation requiring fire-suppression systems in the cargo holds of passenger-carrying airplanes.

As a freighter, the UPS DC-8 was not equipped with, and was not required to be equipped with, a cargo-fire-suppression system (*ASW*, 1/08, p. 36). "As a result, the fire, which began as a smoldering fire in one of the cargo containers, was able to develop into a substantial fire that burned through the container," the report said.

The report said that the FAA rejected previous recommendations in part because it believed that fire-suppression systems would unduly add weight and reduce cargo area aboard freighters. Pointing to the recent development and testing by FedEx of a system that extinguishes fires inside cargo containers before they breach the containers, NTSB again told the FAA that all cargo airplanes should have fire suppression systems. ●

This article is based on NTSB Accident Report NTSB/AAR-07/07: "Inflight Cargo Fire; United Parcel Service Company Flight 1307; McDonnell Douglas DC-8-71F, N748UP; Philadelphia, Pennsylvania; February 7, 2006."

Departure *Deviations*

Problems arise when the assigned SID differs from the one in the FMS.

BY HANS HOUTMAN AND DICK VAN ECK

@ Jeroen Stroes/Jetphotos.net

Unintended deviations from standard instrument departure (SID) procedures are an everyday threat to the aviation system. Unexpected turns or incorrect routes flown soon after takeoff create hazardous situations near airports with heavy traffic or with multiple runways in use.

At Amsterdam Schiphol Airport, for example, there have been several incidents involving pilots who flew a different SID than the one assigned to them by air traffic control (ATC) and acknowledged by the crew.

Schiphol has six runways, some of which converge. Pertinent to this discussion are Runway 24, which is the primary runway for departures, and Runway 18R, the primary runway for landings, under southerly wind conditions. In addition, there is Runway 18L, which also is used occasionally for departures (Figure 1).

The involved airlines use "operational flight plans," which provide pilots with route information, including the SIDs that likely will be followed. An operational flight plan typically is prepared by a flight dispatcher three to six hours before the scheduled departure. The flight dispatcher considers all he or she knows at the time to anticipate the departure runway that will be assigned and to determine which SID can be expected.

Schiphol, like many major airports, is subject to environmental rules and changing meteorological conditions, which sometimes lead to a change of runway configuration after an operational flight plan has been developed and given to the pilots. The pilots might already be on their way to the airport with the operational flight plan for their outbound flight in their pockets.

For aircraft departing from Schiphol's Runway 24, there are two SIDs. They are identified as Spijkerboor 1S and Andik 1S. Although they prescribe different initial turns, both lead toward the same northern airway point. The need for the two different routes is created by tactical use of the runway system. In one runway configuration, the right-turn departure from Runway 24 — Spijkerboor 1S— is preferable; in another configuration, the left-turn departure — Andik 1S — is favored.

Aircraft turning right on departure from Runway 24 can interfere with traffic arriving from the south to establish on a right downwind leg for landing on Runway 18R. Aircraft turning left on departure from Runway 24 can interfere with traffic departing from Runway 18L.

Therefore, when traffic is landing on Runway 18R, aircraft departing from Runway 24 to the north will proceed via the Andik 1S departure (left turn). When Runway 18L also is being used for departures, aircraft departing from Runway 24 to the north will use the Spijkerboor 1S departure (right turn).

On several occasions, pilots departing Schiphol from Runway 24 have turned right after takeoff although they were cleared for the Andik 1S departure, with a left turn away from traffic arriving on right downwind for Runway 18R. On other occasions, it was the other way around: pilots were cleared for the Spijkerboor 1S departure, with the right turn to avoid traffic departing from Runway 18L, but flew the Andik 1S departure toward the traffic coming off Runway 18L.

Pilot-controller communication procedures requiring clearance readback are designed to prevent such errors. Mishearing, however, allows the errors to persist. In most of the departure deviations noted above, the pilots' readbacks of their departure clearances — which included a different SID than the one shown on their operational flight plan — to the clearance-delivery controllers were correct. And on many occasions, though not all, the tower controllers specifically mentioned the assigned SIDs in their takeoff clearances as a final check.

Investigations showed part of the problem was that, in an effort to manage their workload, the pilots had programmed their flight management systems (FMSs) with the SIDs that had been chosen by the flight dispatchers for their operational flight plans. However, no corrections to the programmed FMS routes later were made after different clearances were issued by ATC. Even inclusion of the assigned SIDs in the takeoff clearances did not alert the pilots to the errors. Apparently, the mindset of the pilots was not in line with what actually was put in the FMS.

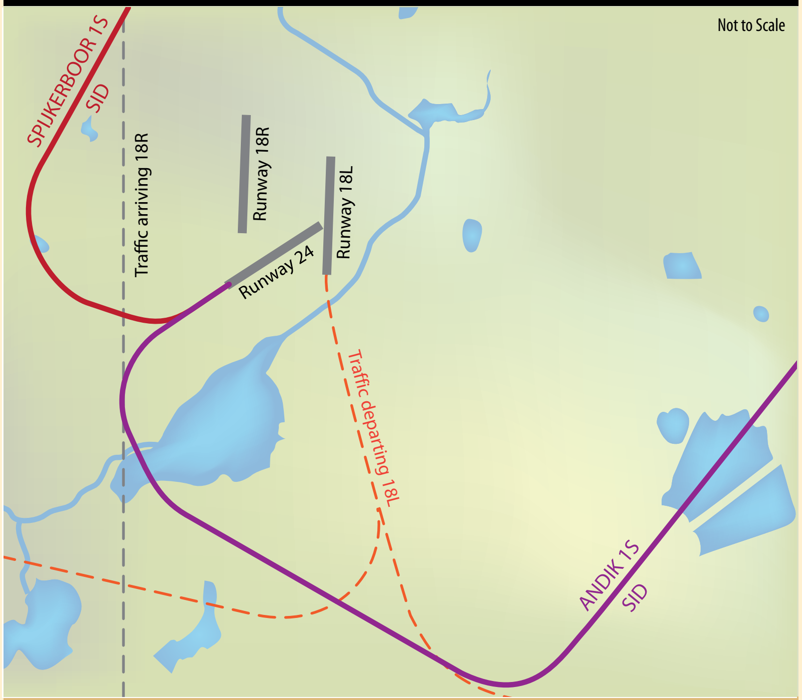
Sometimes, the pilots' readbacks of their clearances were incorrect — the pilots "read back" the SIDs shown on their operational flight plans and not the ones assigned — and the controllers did not notice the errors. The result, however, was the same: the aircraft, on autopilot, followed the SIDs programmed in their FMSs, not the ones assigned by ATC.

The resulting wrong turns sometimes were detected at a very late stage, almost causing a loss of ATC traffic separation, and controllers had to intervene by issuing heading changes and/or level-off instructions to other aircraft in the vicinity to maintain separation. To date, the problem has not resulted in any dangerous situations at Schiphol, but it poses a very real and significant threat to aviation safety.

These incidents are not unique to Schiphol and are not a reflection of one airport's situation. They occur regularly at airports around the world. At Schiphol, the threat was reduced after one of the involved airlines stopped including the expected SIDs in its operational flight plans, instead cautioning pilots to "check SID." Following this change, none of the airline's aircraft has deviated from an assigned SID. ●

Hans Houtman is coordinator-investigator in the office of Performance and Incident Analysis at Air Traffic Control the Netherlands. D.J. "Dick" van Eck is advisor general to ATC the Netherlands on air traffic management training and human factors.

Departure/Arrival Sequences at Schiphol



SID = standard instrument departure

Source: Hans Houtman, Dick van Eck

Figure 1

"At Amway safety is our top priority. That's why we've insisted on FlightSafety's professional training for more than 30 years."

RICH DEVOS
Amway co-founder, NBA Orlando Magic owner and chairman

Rich DeVos co-founded Amway Corp. in 1959 and acquired with his family the Orlando Magic in 1991. He continues to serve on his company's board and travel to deliver his inspirational messages to independent Amway distributors and other audiences. He is the author of *Believe!, Compassionate Capitalism* and *Hope From My Heart: Ten Lessons for Life*, which was inspired by his heart transplant at the age of 71 in 1997.

After more than 80 years, Rich DeVos still looks forward to each day with the same "can do" attitude that propelled him to become one of the world's most successful entrepreneurs. He was barely out of high school when he returned from overseas after service in World War II to start an aviation business with his friend Jay Van Andel. That business and other ventures together took off, and they eventually founded Amway from their homes in 1959. Amway within a few years was a household name, known for pioneering the sales of products through independent distributors. Today the company records over $6 billion in annual sales in more than 80 countries.

Serving a growing global operation required fast, efficient world travel. Amway established a flight department and turned to FlightSafety for aviation training.

"We've been fortunate that Amway has enjoyed tremendous success," DeVos says. "Success requires confidence and persistence and demanding the best of ourselves and others. That's why our flight department insists on FlightSafety's professional, safety-focused training for our jets and helicopters."

The company's belief in the many benefits and advantages of business aviation and the passion DeVos has for aviation continue today. He may have retired from the day-to-day responsibilities of running Amway, but his retirement hasn't slowed him down. When he flies – which he does often as a business leader, philanthropist and speaker – his flight crews are FlightSafety trained. As far as he's concerned, it's the only way to go.

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BY WAYNE ROSENKRANS

Blanket Protection

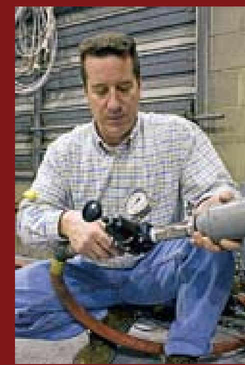
Upgraded thermal acoustic insulation should afford extra minutes to escape a fuel fire before fuselage burnthrough.

U.S. Federal Aviation Administration

A long-awaited fire safety enhancement has moved closer to reality for the global airline industry, the U.S. Federal Aviation Administration (FAA) says. After Sept. 2, 2009, manufacturers of transport category airplanes with passenger seating capacity of 20 or more — including Airbus, ATR, Boeing Commercial Airplanes, Bombardier Aerospace and Embraer — will be required to ensure that thermal acoustic insulation materials installed in the lower half of the fuselage during manufacturing meet upgraded regulatory standards for fire-penetration resistance.

The standards, which also specify insulation flammability criteria and tests of flame propagation in these and smaller transport category airplanes, were issued in September 2003 by the FAA and are being harmonized with regulations of the European Aviation Safety Agency (EASA).[1] Specific considerations of type certification may supersede this rule. For example, the FAA determined in August 2007 that the composite fuselage structure of the Boeing 787 inherently will provide an equivalent level of safety in fire-penetration resistance.

Various factors delayed implementation of this rule, which was proposed in September 2000 and became final in July 2003. The provisions for fire-penetration resistance were to have been effective in September 2007. Most delays were attributed by the FAA to unforeseen circumstances in obtaining equipment such as identical nozzles and airflow vanes for burners in laboratory test rigs, and refining equipment configurations and procedures so that all materials laboratories can



Wayne Rosenkrans

Above, Marker with a next-generation burner. Below, the FAA's "gold standard" insulation-burnthrough test with a Park burner.

© AP photo/Kyodo News. Tomoyasu Yamauchi

All occupants evacuated safely during the China Airlines Boeing 737 pool fire in 2007 before the fire destroyed the cabin.

obtain results that match the FAA's own laboratory tests within accepted tolerances. Other delays involved airframe manufacturers' difficulty — as late as 2006 — procuring compliant insulation materials that would not be heavier or more expensive than those envisioned by the FAA, and their reluctance to commit to materials amid other uncertainties about compliance details.

As of March 2008, however, the FAA expressed confidence that these issues essentially have been resolved and — barring a new major glitch — the effective date stands. After a successful review of its facilities by the FAA, a materials laboratory becomes eligible to conduct certification testing. "At this point, the airframers have candidate materials identified that they will use in their implementations," said Tim Marker, an aerospace engineer and fire research specialist at the FAA William J. Hughes Technical Center. "The bulk of the work is behind us. We have interacted with industry to help set up their tests, especially [reviewing] that they are accurate and their results are traceable back to the results we got at the Technical Center. Their normal process of material screening, material selection and implementation seems to be pretty much on track. A couple of additional visits will be made to some airframers for last-minute tweaks on laboratory equipment, but at this stage, they are ready to start certifying insulation materials for use." The Technical Center also assists the FAA Air Transport Directorate, FAA aircraft certification offices and other civil aviation authorities in ongoing review of the industry compliance activities.

The motivation for the standards is *burnthrough accidents* — survivable events on the ground involving low or no impact forces, in which a large spillage of jet fuel erupts into a pool fire beneath or adjacent to an intact aluminum-skin fuselage. Since the 1960s, fatalities in burnthrough accidents have been rare, primarily because of successful evacuations. Nevertheless, any pool fire is assumed to present a lethal threat because typical 2024-T3 aluminum skin on the lower half of a fuselage can melt and be breached by such a fire in less than one minute. Two barriers beyond the aluminum skin — thermal acoustic insulation blankets and sidewall panels/cabin floors — historically have not been designed for fire resistance. Insulation simply has muffled slip stream noise and helped to maintain cabin temperatures comfortable for occupants.

Thermal Acoustic Materials

Among many possible ways for fire-hardening a passenger airliner,

© Thomas Mitchell/Jetphotos.net

upgrading insulation and its installation has seemed a simple solution. In past practice, the fuselage belly generally has been lined with two layers of 1-in (2.5-cm) lofted fiberglass batting encapsulated in one of many types of protective film that prevents absorption of condensation. "In the sidewall and up near the crown, there can be as many as five layers of 1-in lofted fiberglass," Marker said. "We don't see [manufacturers] abandoning anytime soon the use of lofted materials such as fiberglass for acoustic and thermal insulation."

Construction of a blanket, assuming proper installation, determines how well it can function as a fire barrier. To comply with the new standards, fire-resistant insulation can replace industry-standard fiberglass with a more fire-resistant material, including mixed layers of the new material and fiberglass; a thin fire-resistant material placed inside the lofted fiberglass batting of the blanket; or a fire-resistant film cover that surrounds the batting. For example, one alternate batting material — polyacrylonitrile (PAN) — in place of fiberglass can become the only fire barrier, Marker said. Blanket fabricators also can laminate a very thin barrier, such as ceramic paper, onto film so that the resulting cover itself becomes the fire barrier, he said.

The FAA recognizes that the fire-penetration test — from the airframe manufacturers' viewpoint — is just one of many criteria for selection of insulation materials. "Each [candidate] material probably has to [pass] some 20-odd internal tests for the airframers before it can be used, such as water absorption and thermal conductivity," Marker said. "Throw in weight, cost and burnthrough, and a small group of materials will fulfill all those needs."

More Time to Escape

"[With this rule] we were looking at how we could get people off the airplane before this type of fire — whether it be from a broken or cracked wing or a [ruptured] belly tank or [other fuel leak] — burns through the belly and gets access into the cabin," Marker said. "The whole [FAA fire research] program and all the new test methods that we have developed — not just the burnthrough tests — are really aimed at delaying flashover," a point in fire progression when the cabin environment suddenly becomes non-survivable.

"During flashover, off-gassing of the [cabin] materials that are being burned produces flammable gases, and at some point these all begin to combust with a large release of heat and oxygen [depletion] at the same time," he said. "If we can extend a flashover that normally would have happened at three minutes to five minutes, we have basically given passengers two additional minutes of escape time."

One "landmark" case in the study of burnthrough accidents is the British Air Tours Boeing 737 accident at Manchester, England, in August 1985 in which 55 passengers died, Marker said. Recent examples of burnthrough accidents in which all occupants survived were the Air France Airbus A340 landing overrun accident in Toronto in August 2005 and the China Airlines Boeing 737 pool fire on arrival at the gate in Okinawa, Japan, in August 2007. The China Airlines accident, according to preliminary findings by Japanese accident investigators cited by the FAA in two emergency airworthiness directives, is a reminder of the role that mechanical failures/malfunctions, including uncontained engine failures, may play in burnthrough accidents, Marker said.[2] One of the most recent fatal burnthrough accidents — with 89 fatalities — was the One-Two-Go Airlines McDonnell Douglas MD-82 crash at Phuket, Thailand.

An international search for solutions was prompted partly by safety-benefit analyses sponsored by the FAA in 1999 and 2003, analyzing 17 burnthrough accidents that occurred from 1966 to 1993. The authors argued that the industry would be able to achieve about 12 lives saved annually with fire-resistant insulation.

Full-Scale Awareness

The FAA in the early 1990s studied the effects of pool fires on full-scale surplus commercial jet fuselages by lighting large fuel fires underneath, exposing them to temperatures and heat flux approximating real postcrash fires. "Aluminum skin does vary slightly in thickness depending on where you are in the airplane … the thinnest material would probably last 30 seconds and the thickest material would last maybe 50 seconds [before melting]," Marker said. "But every [pool fire] accident is very scenario-dependent in terms of available exits, fire size and position, wind direction, passenger load, condition of passengers or [a passenger opening an exit to the fire] … all these are critical in the ultimate survivability. Two [identical] airplanes both may have 118 people on board, but you may have very different outcomes because of external [factors]." Researchers then wanted to focus on where external fuel fires entered the cabin.

In the mid-1990s, the FAA constructed a full-scale test rig at the Technical Center. It showed that after penetrating the fuselage skin and any insulation present, a pool fire typically penetrates entry points from below to the fuselage cheek area, then proceeds through cabin floor–level air-return grills. Another way fuel fires penetrate is through a window, which eventually will shrink from exposure to the fuel fire and will fall out of place.

"After a year or two of running full-scale tests [on blankets], we started to develop an appropriate lab-scale test," Marker said.

Laboratory-Scale Replication

The U.K. Civil Aviation Authority and the Direction Générale de l'Aviation Civile of France worked with Technical Center researchers on developing a method for measuring whether insulation blankets could resist for at least four minutes burnthrough caused by a jet of flame from the nozzle of a modified Park burner, the type already familiar to manufacturers for seat flammability tests and cabin panel heat-release tests. Burnthrough is determined either by noting the first appearance of a 0.25-in (0.64-cm) diameter hole or by reading data from thermal flux sensors on the "cold side" of a blanket showing when thermal limits were exceeded. "We used a higher fuel-flow rate so that we could get the thermal insult [flame radiation] needed to simulate the full-scale tests," Marker said. "If [the tester] sees the fire coming through before four minutes, the material fails; [when the tester] looks at the heat-flux trace data, if it was above 2 BTUs per sq ft per second, the material fails."

Industry Feedback

Beginning in 1999, the Technical Center enlisted airframe manufacturers and their insulation suppliers to conduct tests with sets of laboratory apparatus duplicating the Technical Center's "gold standard" rig and with blankets of known characteristics. In these round robin tests, they compared fire-penetration results. For years, results varied too widely to be acceptable; then in 2006 and 2007, the standard deviation dropped to acceptable levels. "Their people perhaps were starting to become more serious after the rule making, to really pay attention [to test details]," Marker said. "The [FAA and industry] refined the test until we were getting a very low standard deviation — significantly below 15 percent — and it became a repeatable test."

Physical characteristics of materials were another challenge. "By nature, thermal acoustic insulation is very light and its density is very low, so it can be influenced a lot by the nature of the flame — any deviations in the very intense fire are going to be magnified," Marker said. "We [issued] a very tight specification as to how to set up this equipment. We also had a very tight standard in terms of the output of the burner. From the [round robin], we were able to improve the apparatus, then we moved into even more refinement, providing calibration materials that we had tested." Specifically, the Technical Center later supplied to other laboratories its "next generation" burner, called a *sonic burner* because its air-choke regulator contains a sonic orifice, also called a critical flow venturi, that substitutes for the Park burner's large cast-aluminum pressure vessel. Either burner can be used for certification of materials.

The Way Forward

The Technical Center continues to conduct research that may or may not lead to standards that complement the current standards. "In an extension of the burnthrough test using the identical sonic burner [attached to an enclosure containing chemical assay instruments],[3] we are exposing the insulation from the standpoint of making sure that no toxic materials come off of it," Marker said. The toxicity test was derived from Technical Center research in fall 2005 on the combustion/non-combustion of composite fuselage materials. Several insulation materials underwent full-scale toxicity tests in late 2007 and early 2008. "If we see [toxicity becoming] a problem at all, I don't know [yet] how it would be handled, whether there would be a new regulation," Marker said. "Any regulation would be in addition to the current standards — it would not impact the compliance date of current standards."

Future Technology

Technological advances likely will be inevitable. "Lighter, better-performing materials can replace older ones, and I don't think insulation will be any exception," Marker said. "We are going to see lighter insulation that still meets this very rigid standard."

Research and development also will continue on intumescent coatings, which were discussed during the rule making process for fire-resistant insulation. When sprayed onto a substrate such as aluminum fuselage skin then exposed to fire, an intumescent coating swells to form a thick insulating barrier that can resist flame penetration. "We ran some tests where the external skin was coated with an intumescent, and it showed a lot of promise," Marker said. More work needs to be done to address the Technical Center's questions about in-service wear of the coatings on aerodynamic surfaces and other issues, and to establish a safety track record for them, he said. Comparatively, insulation in general already has proven to be robust and low-maintenance; blankets are not known to degrade during the service life of an airliner, he said.

Although the regulation allows airframe manufacturers to propose to the FAA alternate means of compliance with the standards, "everyone is sticking to the thermal acoustic insulation approach," Marker said. "However, there have been some variations." One airframe manufacturer is actively pursuing a design for protecting the bottom side of the cabin floor with insulation blankets as the burnthrough barrier. Another likely will continue its practice of attaching blankets to the floor of the cargo compartment rather than line the lowest part of the belly. Airframe manufacturers also are granted some flexibility in configuring the installation of insulation per the new standards.

All configurations have to follow, or provide an equivalent level of safety to, the examples in FAA Advisory Circular 25.852-2, *Installation of Thermal/Acoustic Insulation for Burnthrough Protection.* "We want to make sure they install blankets in such a way that if they do have a fire, the blankets don't fall out and the attachments don't break down," Marker said.

Airlines should expect no significant operational changes as a result of switching to airplanes that have upgraded insulation in the lower half of the fuselage. Extended evacuation time cannot be assumed. "There is no guarantee that occupants are going to get five minutes," Marker said. "There may be an accident where there is such a large fire threat that it completely overwhelms [the fire-resistant insulation barrier]. On the flip side of the coin, there could be an accident where the fire is relatively minor, and the occupants may get eight minutes of protection with this new type of insulation." ●

Notes

1. U.S. Federal Aviation Regulations Part 25.856(a). In the flame-propagation test, insulation material exposed to radiant heat and a propane-burner flame cannot propagate the fire more than 2 in (5 cm) from the flame, and any flame on the material cannot continue more than three seconds after burner removal.
2. FAA. Emergency Airworthiness Directive AD-2007-18-52 said in part, without specifying the accident, "In another case, an initial investigation revealed that following retraction of the slats after landing on a Model 737-800 airplane, loose parts of the main slat track downstop assembly punctured the slat can, which resulted in a fuel leak and a fire that ultimately destroyed the airplane. We issued [AD-2007-18-51] to detect and correct loose or missing parts from the main slat track downstop assemblies, which could result in a fuel leak and consequent fire."
3. The primary instrument for detecting toxic gases in this test is a Fourier transform infrared spectrometer analysis system.

Flawed Report

BY ERIK REED MOHN

Questions about the overrun accident in Toronto went unanswered.

In December 2007, the Transportation Safety Board of Canada (TSB) published its final report on the Air France A340 accident at Toronto in August 2005 (*ASW*, 2/08, p. 40). The crew was faced with rapidly deteriorating weather during the approach, deviated above the ILS glideslope about 200 ft above ground level (AGL), crossed the threshold of Runway 24L 40 ft high, entered an area of heavy rain during the flare and landed 3,800 ft (1,159 m) down the 9,000-ft (2,744-m) runway. This left the crew with 5,200 ft (1,585 m) of available stopping distance. With a 10-kt tailwind and a wet runway, this was not enough; the aircraft ran off the end of the runway at about 80 kt.

International Civil Aviation Organization (ICAO) Annex 13, *Aircraft Accident and Incident Investigation*, and *Manual of Aircraft Accident Investigation*, Doc 6920-AN/855/4, which is currently being replaced by Doc 9756-AN/965, are assumed to have guided the development of this report.

Annex 13 says, "The sole objective of the investigation shall be the prevention of accidents and incidents." Doc 6920 says the purpose of the inquiry is "to determine the facts, conditions and circumstances pertaining to the accident with a view to establishing the probable cause thereof, so that appropriate steps may be taken to prevent a recurrence of the accident and the factors which led to it." Doc 9756 expands on this, saying, "A well-conducted investigation should therefore identify all immediate and underlying systemic causes of an accident and recommend appropriate safety actions aimed at avoiding the hazards or eliminating the deficiencies. … Thus, a properly conducted accident investigation is an important method of accident prevention."

The understanding of this accident hinges in a large part on understanding what the crew actually thought and did, and a transcript of the cockpit voice recorder (CVR) is absolutely essential. This is especially true since the report says that several standard calls were missed and that nonstandard procedures were applied. For example, the report says Air France procedures require the captain to call either "we continue" or "we go around" at decision height (DH). Was this done? We do not know. Although Doc 6920 says that voice recorder readouts "are generally attached as an appendix" to an accident report, this report has no CVR transcript at all. Yet, the report says, "All relevant data were transcribed in full."

The readouts of the flight data recorder, in Appendix F of the report, require a specialist to interpret and should have been expanded and explained in more detail.

In noting Air France's stabilized approach criteria, the report says, "There is no requirement to monitor the localizer and glideslope below 200 ft AGL." However, later on, the report states, "From then on (below the DH), the deviations were below the threshold at which the PNF [pilot not flying] was required to make a call regarding the deviations." These statements are presented as facts but appear to be mutually incompatible and contradictory, and are questionable when compared with Air France's standard operating procedures, which unambiguously state: "After passing decision height, if the visual references, the trajectory or the position of the aircraft evolve in a fashion to compromise the successful completion of the approach or landing, the captain must initiate a go-around or missed approach or aborted landing." I think it is safe to say that the trajectory of this flight evolved in a fashion that compromised the successful completion of the approach and landing. Should the PNF not have called this out?

According to the report, the crew became "overwhelmed" and "task-saturated" after crossing the threshold but were also "committed to landing and believed that their option to go around no longer existed." There is no discussion of why they believed they could not go around, when Air France had taught them that a go-around is safe until the thrust reversers have been deployed.

The A340 has an automatic voice callout of altitude below 50 ft. It also has a voice command, "Retard," if the thrust levers are not retarded to idle below 20 ft in manual landing conditions. These things are not mentioned and discussed in the report.

The facts detailed above add up to an approach that became badly unstabilized and was carried through to a very long landing, resulting in a touchdown at a point where stopping on the remaining runway was impossible. Yet this is not even mentioned in the conclusions section of the report.

ICAO Doc 9756 says that "blame or liability might sometimes be inferred from the [report's] findings. When such is the case, it is essential that all the causes established be clearly presented in the report. To do otherwise would jeopardize the objective of the investigation, which is the prevention of accidents and incidents." Furthermore, it states, "Deviations from the accepted norms of compliance with regulations and procedures should be clearly identified when relevant to the accident … in order to explain the safety implications of the deviation." It also states, "For a contravention to be included as a cause, it should be clear that complying with the regulation or procedure could have prevented the accident or lessened the consequences of the accident."

To me, at least, it is obvious that the contraventions documented in this report are the primary causes of the accident. Complying with the regulations and procedures applicable to this flight would, without doubt, have prevented the accident. In not including the documented contraventions as causes, the report fails miserably. The fact that the relevant Air France procedures and regulations requiring a go-around were ignored by the crew is not even mentioned in the conclusions section of the report. Had a proper go-around been made, this accident would not have happened. Because of the fuel situation, the crew would have had to divert to their alternate, and what would have happened there is impossible to know. But the window they flew through to disaster at Toronto would have closed.

While I am sure that the TSB intended to comply with Annex 13 and other relevant documents, the weaknesses in this report render it almost useless as a tool for learning and preventing future accidents of this kind.

The main problem with this report's misleading and incomplete conclusions is that they prevent a serious discussion of what can be learned from this tragedy and how this kind of accident can be prevented. If this report is allowed to stand as is, it will cheapen the impact of investigation reports everywhere. The best thing to do is to withdraw the report and reopen the investigation in accordance with paragraph 5.13 of Annex 13. ●

Erik Reed Mohn, a fellow of the Royal Aeronautical Society, is an A340/330 captain for SAS. He was co-chair of the FSF ALAR Operations and Training Working Group.

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.

Wayne Rosenkrans

Winning Formula

Challenging questions demanded candid answers from presenters and workshop leaders in February 2008 when the Southern California Safety Institute (SCSI) brought flight attendants and other airline safety, health and security specialists together for the International Aircraft Cabin Safety Symposium (CSS) in Montreal.

People who manage, train and/or compose today's cabin crews increasingly see themselves as agents of change in the aviation safety community, according to Sharon Morphew, SCSI's manager of the CSS, and other symposium organizers (see "Beyond Expectations," p. 46).

Among the most safety-oriented highlights of the symposium (see "Keeping Cool," p. 48, and "Full-Scale Insights," p. 47) were the following messages.

Merlin Preuss, director general of civil aviation in Canada, said that the introduction of safety management systems urgently requires research, open dialogue and global harmonization of solutions for various cabin safety problems. "There will be a rapid increase in the number of seniors in the next five years. … The baby-boomer generation will be traveling more than any other generation," Preuss said. "Cabin crews then can

Left, foreground, Ragna Emilsdottir and Heidi Faith of Air Atlanta Icelandic, and Lisa Crocket of United Airlines. Below, Hilliary.

Wayne Rosenkrans

BY WAYNE ROSENKRANS

Symposium's unflinching focus on concerns raised by flight attendants influences airlines worldwide.

expect to encounter 10 percent of seniors with health issues affecting their mobility or agility or causing pain; 4 percent with hearing impairments; and 3 percent with vision impairments."

Robert Matthews, Ph.D., senior safety analyst in the U.S. Federal Aviation Administration (FAA) Office of Accident Investigation, discussed why the federal transportation policy says lap infants would be significantly safer occupying a secured child restraint system in an airliner cabin, yet the government stops short of requiring parents or guardians to buy extra airline tickets for them. The FAA's position is that the average U.S. family — asked to spend 45 percent more to fly instead of driving a typical highway trip of 480 mi (772 km) — would choose highway travel rather than far-safer airline travel. The FAA argues that a net increase in fatalities would occur — at least 60 more infants killed in motor vehicles compared with one infant traveler's life saved by a child restraint system over 10 years.

Paulo Alves, M.D., medical director of MedAire, said that the aging population will affect the quality and quantity of in-flight medical events. "[The percentage of] people living beyond age 100 is increasing, and not because we are more healthy but because we are surviving our diseases," Alves said. The reason flight attendants must train for rare events — heart attacks, for example — is the extremely short time available to make a difference in the outcome. "The chance of surviving decreases 10 percent every minute; after 10 minutes [without any first aid], you can forget it. … Even if you are over an airport, you will have to wait about 20 minutes before landing — so the responsibility to respond is on flight attendants, nobody else. … [Physician-passengers typically] are not trained to handle out-of-hospital emergencies."

Colette Hilliary, program manager of cabin safety training, FlightSafety International, said that the industry has been reassessing cabin crew training since the investigation of the Helios Airways Boeing 737 decompression accident in Greece in August 2005. One improvement for some airlines has been to ensure that every portable oxygen bottle is preassembled for instant use. Others have introduced flight attendant mixed-gas hypoxia-awareness training, which does not involve a conventional hyperbaric chamber. The training prepares crewmembers to recognize early-onset symptoms and their first/predominant individual symptom, such as tunnel vision or numbness; to observe/hear subtle indications in the cabin; and to take immediate corrective action before losing mental acuity because of hypoxic degradation. "The sensations are different from anything you have ever felt unless you have had hypoxia-awareness training," Hilliary said. "Rapid decompression occurs in one to three seconds, and slow/insidious decompression occurs over more than three seconds. … In a slow/insidious decompression, [flight attendants] may or may not hear whistling near the doors or window seals, the cabin may become cool or appear hazy [but these signs] may be slight. What is the first indication of a slow decompression that we have typically? It is the masks dropping out of the passenger service unit." ●

For an enhanced version of this story, go to <www.flightsafety.org/asw/apr08/css-montreal.html>

Beyond Expectations

The International Aircraft Cabin Safety Symposium (CSS) this year celebrates a quarter century of facilitating the exchange of increasingly specialized knowledge among flight attendants, pilots, airline managers, regulators, aircraft/equipment manufacturers, accident investigators and academic researchers. The airline industry and regulators today count on the expertise, perspective and commitment of flight attendants far more than when the first CSS was held in February 1984, co-founder Barbara Dunn says.

Around that time, the cabin crew's role in survivability of major accidents was coming into sharp focus. The in-flight lavatory fire and emergency landing of Air Canada Flight 797 at Cincinnati in June 1983 — in which 23 passengers were killed by smoke, toxic gases and flash fire about 60 to 90 seconds after evacuation began — was one of many reasons to challenge the status quo, Dunn said. Changes such as floor-level emergency lighting, fire-blocking standards for seat cushions, and higher standards for cabin interior panel flammability and smoke toxicity gradually followed. "Flight attendant training also was improved at that time, with specific attention on firefighting issues," she said.

Dunn was then an Air Canada flight attendant and, from 1974 to 1989, national health and safety chairperson of the Canadian Airlines Flight Attendants Association, now the Airline Division of the Canadian Union of Public Employees. In the late 1970s and early 1980s, she found herself increasingly frustrated with the lack of action on cabin safety issues that most concerned flight attendants.

"In those days, even our safety role on the aircraft was still pretty ill-defined," she said. "We were not given a lot of credit for any of the expertise or knowledge we had. I basically talked to anybody I could about cabin issues. There just wasn't a lot of interest in what was happening on the aft side of the flight deck door. When I was hired as a flight attendant in 1971, all I had to do was be able to write down how to open a door. If I could memorize that portion of my manual and reproduce it on a piece of paper I passed."

Wayne Rosenkrans

Dunn, with her award, and Sharon Morphew of the Southern California Safety Institute.

As a result, Dunn and a few colleagues in 1982 began pitching the idea of a new industry forum dedicated primarily to cabin safety. After first approaching Flight Safety Foundation — which began its International Air Safety Seminar in 1947 and Corporate Aviation Safety Seminar in 1955, and which began publishing *Cabin Crew Safety* in 1956 — she and Toni Ketchell, a flight attendant who in November 1965 survived the American Airlines Flight 383 controlled flight into terrain accident near Cincinnati, turned to Richard Brown, Ph.D., director of aviation safety programs at the University of Southern California Institute of Safety and Systems Management, who joined them in founding the CSS at the university.

Cabin safety specialists from flight attendant unions comprised the majority of CSS attendees in the early years, and their "agitating for improvements" in existing practices gradually gave some people in the industry an erroneous impression of the purpose, Dunn said. "We have fought very hard over the years to dispel that label of being strictly a union group," she said. In later years, the symposium drew more diverse audiences. Flight attendants demanded more sophisticated content and showed willingness to listen to subject specialists holding viewpoints contrary to theirs; and growing emphasis on crew resource management (CRM) helped to bridge differences in professional cultures, she said.

"I have seen a massive improvement in CRM and joint pilot-flight attendant training in CRM," Dunn said. "Most of the people who come to this symposium are in-flight trainers, supervisors and safety managers. Our unions are more knowledgeable now as far as safety is concerned. The industry as a whole looks at us very differently than 25 years ago — we are treated more as safety professionals by the airlines. We are in a position to accept that responsibility in a better fashion."

Brown, Dunn and Ketchell were recognized in Montreal for their roles as the CSS co-founders; Dunn also accepted the Excellence in Cabin Safety Award from the Southern California Safety Institute, which currently conducts the symposium.

— WR

Full-Scale Insights

Airbus shared lessons from its full-scale emergency evacuation demonstration on the A380-800 — many applicable to cabin crews of any airliner — during the International Aircraft Cabin Safety Symposium. Videos of the evacuation, as recorded by overhead interior cameras, revealed more clues to how the two pursers and 16 flight attendants in March 2006 evacuated 873 people in 78 seconds via three upper-deck slides and five lower-deck slides in Hamburg, Germany (*ASW,* 1/07, p. 46).

"The behavior and assertiveness of the cabin crew had a great impact on the speed with which they managed and directed the passengers and the exits," said Carmen Jacobs, cabin crew training policy manager, Airbus Training and Flight Operations Support and Services. "The successful evacuation in less than 90 seconds came about with the crowd-control techniques, our attitude and our different approach as instructors towards the cabin crew we were training. The crowd-control techniques can be used for any type aircraft."

Training on a subset of the type-specific curriculum comprised 14 hours, half theory/half practice, over three days, plus a half-day visit to the demonstration aircraft. "During the aircraft visit, trainees were all told to look around, try out every cabin crew station and stand in every assist space," Jacobs said. "They had to check what they could see and with whom they could communicate."

Jacobs and her colleagues decided at the outset that psychological preparations would be essential — specifically for each flight attendant to be able to continuously manage the situation, be assertive and be direct. Training would prepare them to mentally focus on their crowd-control techniques, not on the crowd. "We had to work with attitude — we had to give the crew confidence in being able to handle a crowd," she said. "We had to teach them [not] that they *can be* in control — that they *are* in control."

Asserting control then called for specific attention on how to combine conventional commands with delivery techniques that likely would work even for passengers who do not know the language being spoken by the cabin crew. "We started off with teaching them how to shout," Jacobs said. "Assertive, short, loud and clear commands have no meaning without the correct body language, gestures and facial expressions. There is no point in shouting a command with a big smile on your face — no one will take you seriously. Gestures are as important as commands and should be used in tandem." The videos show all the flight attendants shouting and gesturing at a high level of intensity, as if expressing extreme anger to all the passengers.

Instructors deliberately spent time building trust and friendship during breaks/lunches, mixing humor and frequent reminders that each flight attendant is in control with personal challenges to perform at their best. "We worked with their individuality … their personalities and skills," Jacobs said. "They all encouraged one another to practice being able to do things simultaneously and to increase the speed of their actions."

For an enhanced version of this story, go to <www.flightsafety.org/asw/apr08/a380-insights.html>.

—WR

Airbus A380-800; Jacobs.


© Fraport


Wayne Rosenkrans

Keeping Cool

Differences between what airline management rates as a comfort/convenience issue and what flight attendants consider unsafe/unhealthy can be difficult — but not impossible — to resolve and objective data help, several presenters told the International Aircraft Cabin Safety Symposium.

Christopher Witkowski, director of air safety, health and security for the Association of Flight Attendants–Communications Workers of America (AFA–CWA), recapped controversy surrounding cases of exposure to particles of engine oil, hydraulic fluid or byproducts contaminating the air provided by the environmental control system of a passenger airliner. Past studies have yet to put these concerns to rest, Witkowski said.

By early 2008, several initiatives were in place to help find answers. Voluntary U.S. health care protocols — *Management of Exposure to Aircraft Bleed Air Contaminants Among Air Line Workers: A Guide for Health Care Providers* at <www.ohrca.org> — have been drafted under a joint initiative of the Occupational Health Research Consortium in Aviation (OHRCA) and the U.S. Federal Aviation Administration Airliner Cabin Environment Research (ACER) Center of Excellence, both funded under a 2003 federal law.

Flight attendants from two airlines participated in the feasibility phase of a new cabin air quality study June–December 2007 and returned 4,012 completed surveys; a report will be published later in 2008. In first-phase feasibility testing, researchers had activated air samplers on 47 of 67 paid flight segments as of February 2008.

AFA-CWA also described a problem-solving partnership with an unspecified airline to look at how heat stress in a tropical climate might affect occupants of some ATR 72 aircraft flying in south Florida, U.S., and Caribbean airports (see figure). "These aircraft are not configured to have an auxiliary power unit on board, so they are extremely reliant on ground cooling," said John Grace, national health committee representative. "We had to come up with a testing protocol that would create accurate data that would show or disprove that there actually was a heat problem … we needed to know what the heat index was." During August 2006, specially trained flight attendants collected simultaneous temperature-humidity measurements at the forward flight attendant jump seat just prior to closing the boarding door at 12 airports. Measurements also were collected at the top of descent for a total of 585 flights.

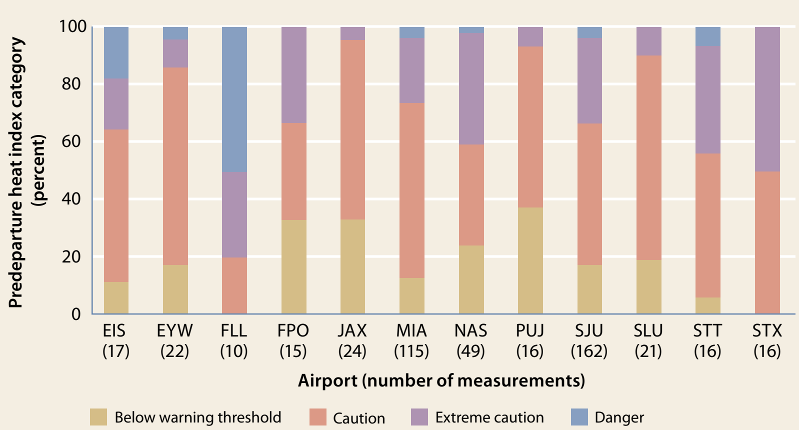
The flight attendants also recorded physiological signs observed in passengers or crew, illness symptoms reported by passengers or crew, and aircraft-related causal factors. The research relied on the *U.S. National Oceanic and Atmospheric Administration [NOAA] Heat Index* <www.crh.noaa.gov/pub/heat.php> and its categories of heat disorders for people in high risk groups. In presenting results to management, the union recommended that the company conduct a periodic analysis of problem stations and aircraft; continue a new policy for replacing ground air conditioning carts; educate flight crews about heat stress; teach and enforce policies/procedures to be used when hot aircraft are encountered; and maintain strategic awareness of heat stress and its safety implications.

Follow-up by management revealed that some ground staff did not recognize that a comfortable ambient temperature of 70 degrees F (21 C) usually had no bearing on the morning aircraft heat soak, and that many airplanes in the fleet had a ducting system in their environmental control system configured for maximum heating effect during winter operations, Grace said. The airline assigned a full-time ground monitor responsible solely for preventing excessive heat conditions.

—WR

Wayne Rosenkrans

Grace



Source: Association of Flight Attendants — Communications Workers of America

Maintenance Check

Incorrect installation, inadequate control are highlighted in U.K. maintenance-error reports.

BY RICK DARBY

Among 21 "high-risk" maintenance-error reports studied by the U.K. Civil Aviation Authority (CAA) from 1996 through 2005, 12, or 57.1 percent, involved "incorrect maintenance actions," six, or 28.6 percent, involved "incomplete maintenance" and three, or 14.3 percent, involved poor "maintenance control."[1]

Of a much larger number of maintenance-error incidents of all risk levels in the same study period, about half were attributed to "incorrect maintenance actions," and about a quarter each to "ineffective maintenance control" and "incomplete maintenance."

The data were derived from the CAA's mandatory occurrence reporting (MOR) program and included reports involving jet aircraft heavier than 5,700 kg — considered equivalent to 12,500 lb — maximum takeoff weight.[2] The analysis began with a database of 3,535 MORs citing maintenance error, although 611 reports were eliminated from the study because they were judged nonpertinent, leaving 2,924.

An earlier study limited to 312 MORs had developed a taxonomy that sorts maintenance incidents into "maintenance control," "incomplete maintenance" and "incorrect maintenance action" categories.[3] For this latest study's data set, the CAA added second-level descriptors and Air Transport Association of America (ATA) chapters categorizing the affected components (Figure 1, p. 50).[4]

Table 1 (p. 50) shows the distribution of MORs among the three maintenance-error types and the second-level descriptors within each type. The three most frequent ATA chapters in the data set were chapter 25, "equipment and furnishings," with 19.2 percent of the total; chapter 32, "landing gear," with 11.0 percent; and chapter 27, "flight controls," with 9.0 percent. When all the chapters, 71–80, related to engines were combined, however, the maintenance errors represented 15.0 percent of the data set, making engine maintenance error second only to "equipment and furnishings."

Figure 2 (p. 51) shows the breakdown of selected reports under the ATA chapter "equipment and furnishings." The CAA report said, "By far the most common problem is with escape slides, accounting for 42.0 percent of the occurrences in ATA [chapter] 25. Cabin dividers

Maintenance Error Types and Second-Level Descriptors

Maintenance occurrence

Maintenance control	Incomplete maintenance	Incorrect maintenance action
Airworthiness data Airworthiness directive Certification Component robbery* Configuration control Deferred defect MEL interpretation Modification control Scheduled task Technical log Inadequate tool control	Not fitted Not set correctly Not removed	Incorrect fit Incorrect part Incorrect procedure Incorrect repair Not fitted Not set correctly Poor maintenance practice Procedure not adhered to Not removed

MEL = minimum equipment list

* E.g., inadequate control of parts removed from one component or aircraft to be fitted to another.

Source: U.K. Civil Aviation Authority

Figure 1

Maintenance-error MORs as a percentage of total MORs received during the study period varied from a high of 5.9 percent in 1997 to a low of 3.0 percent in 2005.

were a particular problem that one operator had and generated 67 occurrences between 1996 and 2004. Issues relating to passenger seats were mainly associated with inadequate attachment to the aircraft structure."

Maintenance-error reports classified as "landing gear" were fairly evenly divided among wheels, gear and brakes (Figure 3). "The most frequent problem with wheels was associated with fitting the wheel itself (34.0 percent of the wheel issues), while by far the most frequent issue with 'landing gear' was associated with landing gear safety pins, accounting for 42.0 percent of the 'landing gear' occurrences," said the report.

For the ATA "flight controls" chapter, the most frequent reports involved the flaps/slats system, the report said (Figure 4). Among MORs related to the combined ATA engine chapters, further analysis "showed little of significance," the report said. Errors involving foreign object debris, borescopes, latches, bolts, seals, panels and compressor washes accounted for 3 percent or less each. Fully 80.0 percent

U.K Reported Maintenance Errors, 1996–2005

Type	Number	Percent Within Type
Maintenance control		
Scheduled task	223	30.4
Inadequate tool control	84	11.5
Deferred defect	81	11.0
Airworthiness data	78	10.7
Tech log	67	9.2
Airworthiness directive	66	9.0
Modification control	55	7.5
MEL interpretation	37	5.0
Configuration control	23	3.1
Certification	13	1.8
Component robbery	6	0.8
Total	**733**	
Incomplete maintenance		
Not fitted	268	44.5
Not set correctly	229	38.0
Not removed	105	17.5
Total	**602**	
Incorrect maintenance		
Incorrect fit	619	39.0
Not set correctly	447	28.1
Incorrect part	160	10.1
Poor maintenance practice	94	5.9
Procedure not adhered to	83	5.2
Not fitted	78	4.9
Incorrect repair	62	3.9
Incorrect procedure	24	1.5
Not removed	22	1.4
Total	**1,589**	
Grand total	**2,924**	

MEL = minimum equipment list

Note: Maintenance errors were reported in the U.K. Civil Aviation Authority mandatory occurrence reporting (MOR) program.

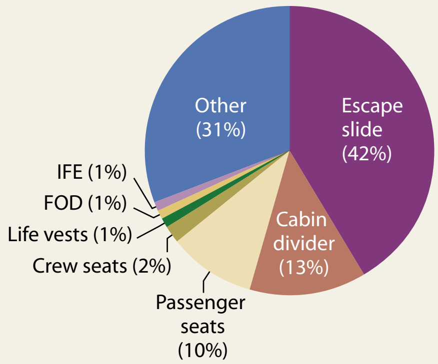
Source: U.K. Civil Aviation Authority

Table 1

were categorized as involving "other" engine components or events.

Maintenance-error MORs as a percentage of total MORs received during the study period

U.K. Reported 'Equipment and Furnishings' Maintenance Errors, 1996–2005



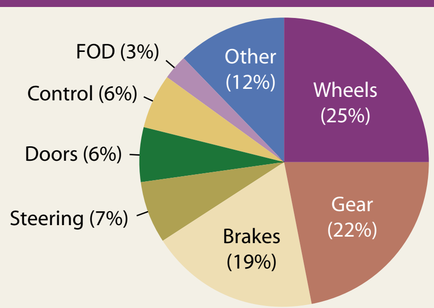
FOD = foreign object debris
IFE = in-flight entertainment system

Note: Categories are based on the Air Transport Association of America (ATA) Specification 100 Code, Chapter 25, "Equipment and Furnishings."

Source: U.K. Civil Aviation Authority

Figure 2

U.K. Reported 'Landing Gear' Maintenance Errors, 1996–2005



FOD = foreign object debris

Note: Categories are based on the Air Transport Association of America (ATA) Specification 100 code, Chapter 32, "Landing Gear."

Source: U.K. Civil Aviation Authority

Figure 3

varied from a high of 5.9 percent in 1997 to a low of 3.0 percent in 2005.

The 21 MORs during the study period that the CAA classified as "high risk" were distributed according to second-level descriptors as shown in Table 2 (p. 52). The three individual ATA chapters associated with the reports were "landing gear," with five events, or 23.8 percent; "flight controls," with four events, or 19.0 percent; and "engine," with three events, or 14.3 percent. Maintenance errors for the combined engine-related ATA chapters, including chapter 72, "engines," totaled five.

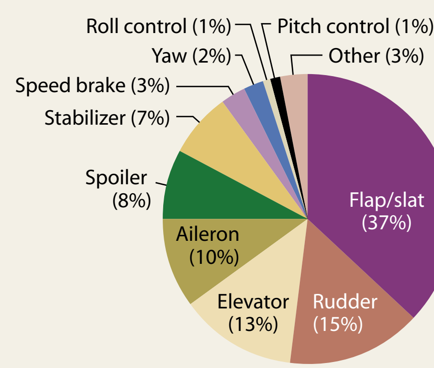
The report discussed the three maintenance error types:

Incorrect maintenance action: The report said that this was "clearly the most common category," and "the issues are largely focused around the incorrect installation of components, although it is not possible from the data available to determine the underlying attributable causes."

Maintenance control: "The focus of human factors initiatives has largely been on understanding and preventing maintenance error based upon the premise that the system, designed to support the engineers [maintenance technicians], is robust and effective," the report said. "As can be shown from the data, maintenance control issues contribute just as significantly to maintenance error in terms of their effect. Errors associated with configuration control, deferred defects and control of airworthiness directives can impact the integrity of the aircraft in the same way as the actions of the maintenance [technician]."

"Failure to perform scheduled tasks" was the most common error among the second-level descriptors within the "maintenance control" type, with 223 MORs, or 30.4 percent, falling into that category. "The second largest number of errors within 'maintenance control' was hazards relating to inadequate tool control," the report said. "There were 84 occurrences where this was the primary cause of the hazard affecting the aircraft. Of these 84 events, 43 (51.0 percent) were due to personnel inadequately controlling their own personal tools or belongings. … Just three (4.0 percent) of the

U.K. Reported 'Flight Controls' Maintenance Errors, 1996–2005



Note: Categories are based on the Air Transport Association of America (ATA) Specification 100 code, Chapter 27, "Flight Controls."

Source: U.K. Civil Aviation Authority

Figure 4

U.K Reported 'High Risk' Maintenance Errors, 1996–2005

Type	Number	Percent Within Type
High-risk incidents — maintenance control		
Scheduled task	3	100.0
Airworthiness data	0	0.0
Airworthiness directive	0	0.0
Certification	0	0.0
Component robbery	0	0.0
Configuration control	0	0.0
Deferred defect	0	0.0
Inadequate tool control	0	0.0
MEL interpretation	0	0.0
Modification control	0	0.0
Tech log	0	0.0
Total	**3**	
High-risk incidents — incomplete maintenance		
Not fitted	4	66.0
Not set correctly	1	17.0
Not removed	1	17.0
Total	**6**	
High-risk incidents — incorrect maintenance		
Incorrect fit	6	50.0
Not set correctly	3	25.0
Incorrect part	1	8.3
Poor maintenance practice	1	8.3
Procedure not adhered to	0	0.0
Not fitted	0	0.0
Incorrect repair	1	8.3
Incorrect procedure	0	0.0
Not removed	0	0.0
Total	**12**	
Grand Total	**21**	

MEL = minimum equipment list

Note: Maintenance errors were reported in the U.K. Civil Aviation Authority mandatory occurrence reporting (MOR) program.

Source: U.K. Civil Aviation Authority

Table 2

events involved tools that would have been issued to personnel for which the system would have demanded their return to stores after the work had been completed."

Aircraft maintenance personnel in the United Kingdom invariably own their own standard equipment, the report said. "These tools are not subject to a real system of control other than the owner being responsible for ensuring that he does not leave any in the aircraft after completing the task. … The data suggest that the control of company-owned special tools is performing its job, but the control of personal tools is not as robust."

Incomplete maintenance: "Occurrences related to incomplete maintenance typically involved such things as not tightening pipes or screws at the end of a task or omitting wire locking," the report said. "These errors are more typical of a human error or lapse than performing the job incorrectly, as is the case with occurrences categorized as incorrect maintenance."

Noting that there was a decrease in maintenance MORs as a percentage of all MORs, particularly between 2001 and 2002, the report speculated that the drop "may be explained by the CAA campaigns, conferences and road shows in 1999 and 2000 on maintenance error management, culminating in the issuing of Airworthiness Notice 71 in March 2000.[5] Airworthiness Notice 71 laid out CAA's policy on error management and the expectation that maintenance organizations adopt good human factors principles and practices in the form of instituting error management programs in their organizations." ●

Notes

1. CAA Safety Regulation Group. "Aircraft Maintenance Incident Analysis." CAA Paper 2007/04, December 2007. Available via the Internet at <www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=2971>.

2. CAA, Safety Regulation Group. CAP 382, *The Mandatory Occurrence Reporting Scheme: Information and Guidance.* November 2005. Available via the Internet at <www.caa.co.uk/docs/33/CAP382.PDF>.

3. *Maintenance control* was defined as "an event attributed to an ineffective maintenance control system."

   Incomplete maintenance was defined as "an event where the prescribed maintenance activity is prematurely terminated. In these circumstances, the correct maintenance procedures appear to have been followed, but something was not removed, not fitted or not set correctly towards the end of the process."

   Incorrect maintenance action was defined as "an event where the maintenance procedure was completed but did not achieve its aim through the actions or omissions of the maintainer." The report said, "In these circumstances, it appears that an incorrect maintenance procedure or practice was being used. This has resulted in a larger number of second-level descriptors than incomplete maintenance, but includes the actions of not removing, not fitting or not setting something correctly by virtue of not performing the task correctly, rather than as an error or omission."

4. ATA chapters are based on its Specification 100 codes for failed components.

5. CAA. Airworthiness Notice 71. Available via the Internet at <www.chirp.co.uk/New/Downloads/MEMS/Notice71.htm>.

Culture Shock

Defining acceptable behavior in a 'just culture' has its pitfalls.

BOOKS

Just Culture: Balancing Safety and Accountability

Dekker, Sidney. Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2007. 165 pp. Figure, table, index.

"No longer do we see accidents as meaningless, uncontrollable events," Dekker says. "On the contrary: accidents are evidence that a particular risk was not managed well enough."

From there it is only a short step to perceiving an accident as a "failure" of risk management. Someone's job wasn't done right. Someone must be blamed.

That normal — if questionable — reaction to an accident stands in the way of an opposite trend in risk management, which is to look at the accident as a systemic failure, not the error of a particular person or persons. According to this view, the important thing is to create an atmosphere of organizational trust, in which people readily acknowledge problems that could lead to an accident, or that were involved in an incident or accident, so that the causal factors can be systematically resolved.

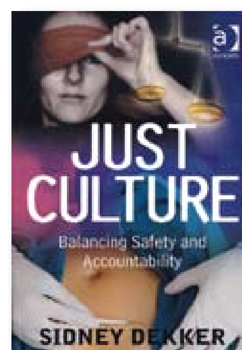
There is a tension between these two ways of looking at a situation. A "no blame" culture can encourage transparency and allow the organization, not just individuals, to learn from mistakes. Realistically, however, no organization can afford an absolute hands-off policy toward people associated with bad events. Not only does it go against human nature, it doesn't acknowledge that negligence and irresponsibility exist.

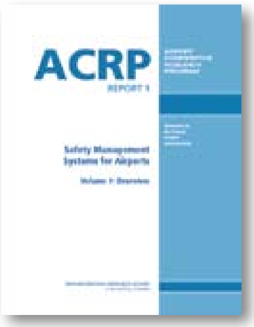
Trying to reconcile these two value systems has led to a keen interest in the idea of a "just culture" — one that is neither weighted toward finding fault nor infinitely tolerant. Fairness and justice are its keynotes.

"A just culture is something very difficult to define, as 'justice' is one of those essentially contested categories," Dekker says. "'Essentially contested' means that the very essence, the very nature, of the concept is infinitely negotiable. But that does not mean we cannot agree, or make some progress on, some very practical problems related to what we could call a just culture."

In the abstract, it is easy enough to come up with a verbal formula to describe a just culture. Most people would agree that there is a vast realm in which honest mistakes take place, and that those who make them ought not to suffer as a result, but a "line" separates that realm from negligent or even criminal behavior. Nevertheless, says Dekker, "We delude ourselves that there should be consequences for operators or practitioners who 'cross the line.' … We don't realize that lines don't just exist 'out there,' ready to be crossed or obeyed, but that we — people — construct those lines, that we draw them differently every time, and that what matters is not *where* the line goes — but *who* gets to draw it."

Dekker cites one typical, and long, definition of negligence that uses terms such as "normal standard," "reasonably skillful," "reasonable care" and "prudent," with a failure to meet such benchmarks considered negligent.





"Rather than clarifying which operational behavior is 'negligent,' such a characterization shows just how complex the issue is," Dekker says. "There is an amazing array of judgment calls to be made. Just see if you, for your own work, can (objectively, unarguably) define things like 'normal in the community,' 'a reasonable level of skill,' 'a prudent person,' 'a foresight that harm may likely result.' … And don't we all want to improve safety precisely because the activity we are engaged in can result in harm?"

In addition, Dekker says, judgments about whether an act was negligent, reckless or otherwise "over the line" are subject to hindsight bias. That is, knowing the outcome, it is almost impossible to understand the situation as it appeared to someone who didn't have foreknowledge of what would happen.

"Of course, it is not that making such judgments is impossible," Dekker says. "In fact, we probably do this quite a lot every day. It is, however, important to remember that judgment is exactly what [it is]. … What matters is which processes and authorities we in society (or you in your organization) rely on to decide whether acts should be seen as negligent or not."

He is very concerned about the trend toward mixing accident investigations with judicial proceedings. (See "Deterring Criminalization," *ASW*, 3/08, p. 12.) "As long as there is fear that information provided in good faith can end up being used by a legal system, practitioners are not likely to engage in open reporting," he says. "Many admit that they will only file a report when there is the chance that other parties will disclose the incident (for example, an air traffic controller may think that a pilot will report a close call if he or she does not), which would make the event known in any case. This puts practitioners in a 'Catch-22' [an insoluble dilemma]: either report facts and risk being persecuted for them, or not report facts and risk being persecuted for not reporting them. Many seem to place their bet on the latter: rather not report and cross [their] fingers that nobody else will find out either."

There is no evidence that a judicial system will improve safety, Dekker says: "The idea that a charged or convicted practitioner will serve as an example to scare others into behaving more prudently is probably misguided: instead, practitioners will become more careful only in not disclosing what they have done. The rehabilitative purpose of justice is not applicable either, as there is usually little or nothing to rehabilitate in a pilot or a nurse or air traffic controller who was basically just doing his or her job. Also, correctional systems are not equipped to rehabilitate the kind of professional behaviors (mixing medicines, clearing an aircraft for takeoff) for which people were convicted.

"Not only is the criminalization of human error by justice systems a possible misuse of tax money — money that could be spent in better ways to improve safety — it can actually end up hurting the interests of the society that the justice system is supposed to serve."

Despite the problems inherent in defining what is allowed in a just culture, Dekker says that many organizations adopt pragmatic solutions that work reasonably well. Those solutions, he says, derive from answering three central questions: Who in the organization gets to draw the line between acceptable and unacceptable behavior? What should be the role of domain expertise in judging whether behavior is acceptable or unacceptable? And how protected are safety data against judicial interference?

REPORTS

Safety Management Systems for Airports. Volume 1: Overview

Ludwig, Duane A.; Andrews, Cheryl R.; Jester-ten Veen, Nienke R.; Laqui, Charlotte. Washington, D.C.: Transportation Research Board of the National Academies, Airport Cooperative Research Program (ACRP) Report 1. 2007. 39 pp. Figures, photographs, list of abbreviations. Available via the Internet at <www.trb.org/news/blurb_detail.asp?id=7918> or from the National Academies.*

"This report provides a brief description of a safety management system (SMS) and is intended to be an easy-to-read, quick introduction to SMS for airport directors and their governing boards," the report says. "It describes the advantages associated with instituting such a system and explains the four components or pillars (safety policy, safety risk management, safety assurance and safety promotion) that are part of an SMS. The report also provides the background information on the International Civil Aviation Organization's (ICAO's) requirements for SMS at airports and relates the experiences of airports located outside the United States in implementing SMS."

SMS represents a "next level" approach to safety management, which goes beyond analyzing past accidents and acting to remedy defects found to have been causal factors. It is based on prevention, not only cure. More than that, when an SMS is in place, prevention efforts are not random or brought about just by individuals; they are a fixed, standardized component of every level of an organization.

"A well-structured SMS provides a systematic, explicit and comprehensive process for managing risks," the report says. "This process includes goal setting, planning, documentation, and regular evaluation of performance to ensure that goals are being met."

Among the benefits of SMS for airports, the report says, are reduction of the direct and indirect costs of accidents; improved employee morale and productivity; logical prioritization of safety needs; legal compliance; more efficient maintenance scheduling and resource use; avoiding operational disruptions; and continuous improvement of operational processes.

After sections on ICAO guidance for airport SMS and the experience of airports outside the United States, the report considers a "Vision of SMS Implementation at U.S. Airports." It looks at FAA activities undertaken or planned under U.S. Federal Aviation Regulations Part 139, *Certification of Airports*. FAA has also published Advisory Circular 150/5200-37, *Introduction to Safety Management Systems for Airport Operators.*

The report lists steps that airport managements should be taking or planning to prepare for the SMS that ICAO and the FAA have envisioned:

- "Establish a safety policy and assign safety responsibility. Responsibility for overseeing the SMS implementation must be assigned at an early stage. … The first task is establishing a safety policy that reflects SMS principles.
- "Perform a gap analysis. Compare existing safety components with SMS program requirements and identify all elements that require development. A gap analysis frequently begins with a list of all the current operations and procedures that occur at the airport. One can then verify whether they are performed in accordance with SMS philosophies.
- "Develop a strategy for SMS implementation. This is essentially a roadmap that lays out the steps required to fully implement SMS. The experience of other airports using SMS may prove helpful in determining an efficient phased approach and transition plan.
- "Develop individual SMS elements. Following the roadmap, the processes that make up SMS must be developed, documented, reviewed and verified."

This overview will be followed by the development of a guidebook that will provide detailed information about how to develop an SMS at an airport. The guidebook is expected to be completed in the last quarter of 2008 and published as the second volume of this report in 2009.

WEB SITES

International Helicopter Safety Team, <www.ihst.org>

In January 2006, industry and government leaders, following the U.S. Commercial Aviation Safety Team model, created the International Helicopter Safety Team (IHST). Team members represent helicopter associations, operators, manufacturers, regulatory authorities, research facilities and other groups from Canada, Europe, the United States and other countries.

A banner on each Web page highlights the IHST goal: "To reduce the [worldwide] helicopter accident rate by 80 percent by 2016."

IHST provides a considerable amount of information on its public site. Examples are:

- Safety analysis reports from Australia, Canada, the United Kingdom and United States, including titles such as *The U.S. Joint Helicopter Safety Analysis Team: Year 2000 Report to the International Helicopter Safety Team*, September 2007 (an analysis of 197 helicopter accidents in one year considered representative of accidents in other recent years);

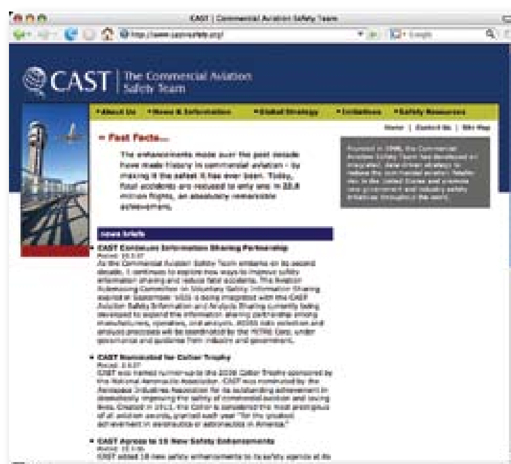
- A list of member organizations with active links to their Web sites;
- *The Safety Management Systems Toolkit*, edition 1, a compilation of best practices and solutions from small, medium and large helicopter operators; airlines; industry groups; and governments. Using a performance-based approach, the 40-page document says it "helps the organization determine [its] level of compliance and develop an action plan to include the necessary components"; and,
- Fourteen categories of additional resource materials to support information presented in the tool kit, such as risk assessment tools, safety communications, safety training, performance measurements, forms, checklists and sample cases.

Commercial Aviation Safety Team, www.cast-safety.org/index.cfm

The Web site says that CAST "identifies the top safety areas through the analysis of accident and incident data; charters joint teams of experts to develop methods to fully understand the chain of events leading to accidents; and identifies and implements high-leverage interventions or safety enhancements to reduce the fatality rate in these areas."

CAST was formed in 1998 as a cooperative U.S. government–industry initiative to identify and implement safety enhancements to reduce the commercial aviation fatality rate in the United States. Its success has enabled it to expand internationally and form regional safety alliances to strategically target commercial air carrier accident prevention. Contact information for international partners and government and industry members is listed.

The Web site provides organizational background and descriptions of the three types of CAST joint safety teams (safety analysis, data analysis and implementation); the CAST Safety Plan; a list of safety enhancements completed or under way; its glossary and taxonomy; CAST reports (1998–2007); and PowerPoint presentations. All can be viewed in full text online, and printed or downloaded at no cost. Some documents are large, in color and contain figures and tables. ●



Source

* Transportation Research Board
Business Office
500 Fifth St., NW
Washington, DC 20001 USA
Internet: <www.national-academies.org/trb/bookstore>

— *Rick Darby and Patricia Setze*

Bogus Stall Warning

Stick shaker activated four seconds after liftoff.

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

False Alarm Traced to Slat Sensor Signal

Boeing 717-200. No damage. No injuries.

The 717 was departing from Alice Springs, Northern Territory, Australia, for a scheduled flight with 63 passengers to Perth, Western Australia, the morning of Aug. 2, 2006, when the flight crew received warnings of an impending stall. The aircraft was about 31 ft above the runway, and the pilots were retracting the landing gear when the stick shaker activated and airspeed warnings appeared on the primary flight displays, said the report by the Australian Transport Safety Bureau (ATSB).

The report said that the crew had used appropriate takeoff settings and techniques. Pitch attitude was 4.5 degrees at liftoff and had increased to 16 degrees, resulting in an angle-of-attack of 11 degrees, when the stall warnings began. Airspeed was 160 kt — 39 kt higher than the stall speed corresponding to the aircraft's weight and flaps/slats setting. "The aircraft did not approach an aerodynamic stall condition at any time during the [four-second] stick shaker activation," the report said.

The crew responded appropriately to the stall warning, the report said. The copilot, the pilot flying, applied maximum thrust and maintained the existing pitch attitude. The pilot-in-command (PIC), concerned that the stick pusher might activate, applied forward pressure on the control column to reduce the pitch attitude. The 717 was about 168 ft above the runway when the stick shaker ceased. "The crew maintained the aircraft in the existing configuration — landing gear retracted, and the wing flaps and leading edge slats extended — until the aircraft climbed clear of the surrounding terrain," the report said.

The weather was clear, and the PIC told investigators that visual contact with the ground was maintained throughout the incident. After consulting with company engineers, the crew decided to continue the flight to Perth.

The report said that the false stall warnings likely were triggered by an incorrect signal generated by one of the two left wing slat proximity sensors; the other sensor generated a correct signal. "Consequently, the different slat-position signals from the two sensors in the left wing resulted in the PSEU [proximity-sensing electronics unit] defaulting to the slats-not-extended indication for the left wing," the report said. "As a result of the different slat-position signals sent by the PSEU for the left wing (slats not extended) and right wing (slats extended), the aircraft's flight control computers used the flaps-extended/slats-retracted stick shaker angle-of-attack schedule, leading to stick shaker activation and other stall indications."

According to Boeing, the 717 stick shaker activates at an angle-of-attack of 16.3 degrees with flaps and slats extended, and at 9.5 degrees with flaps extended and slats retracted.

False stall warnings previously had been reported by two other 717 flight crews. Both incidents occurred during approaches; one was traced to a faulty right slat proximity sensor, the other to a PSEU failure.

Boeing, which participated in the investigation, told ATSB that "there were no conclusive findings to establish a root cause of the three reported 717 events" and that "there does not seem to be a systemic problem for this issue in the 717 fleet," which comprises 156 aircraft.

Abnormal Deceleration Misdiagnosed

BAe 146-200. Substantial damage. No injuries.

The aircraft was inbound with 55 passengers to London City Airport from Paris Orly Airport the morning of Feb. 20, 2007. The U.K. Air Accidents Investigation Branch (AAIB) report said that weather conditions were "benign," with surface winds from 170 degrees at 5 kt. Runway 10, the landing runway, was damp.

The report said that airspeeds appropriate for the 146's landing weight, 32 tonnes (70,548 lb), included a reference landing speed (VREF) of 110 kt and a touchdown speed of 103 kt (VREF minus 7 kt). The landing data card prepared by the flight crew showed a VREF of 119 kt. Recorded flight data indicated that the aircraft touched down at 119 kt with a level pitch attitude at the end of the runway touchdown zone, about 330 m (1,083 ft) from the approach threshold.

"The data also shows that the lift spoilers did not deploy and suggests that the aircraft was probably close to 'wheelbarrowing' during the early part of the landing roll, mainly as a consequence of the lack of spoilers," the report said. "It is likely that the main landing gear was compressed only just enough to 'make' the weight-on-wheels switches, with the aircraft mainly supported by aerodynamic lift from the wings."

"Toward the end of the skid, all four main landing gear tires burst."

The commander said that he perceived "not a hint of deceleration" and, believing that the Green hydraulic system wheel brakes had failed, selected the Yellow hydraulic brake system. The aircraft continued "coasting down the runway," and the commander selected the Emergency Yellow brake system, which does not include anti-skid.

Skid marks from the four tires on the main landing gear extended 473 m (1,552 ft) to where the 146 stopped on the paved undershoot area for Runway 28. "Toward the end of the skid, all four main landing gear tires burst," the report said.

No system malfunctions were found, and the 146 was returned to service after the wheels and tires were replaced. The report did not specifically state why the lift spoilers did not deploy but noted that a friction test revealed that a force of 14 lb (6 kg) was required to move the lever through the airbrake position detent into the lift spoiler position and that the aircraft had not been modified in accordance with a nonmandatory service bulletin requiring a maximum force of 12 lb (5 kg).

"Previous AAIB investigations have found that pilots commonly misdiagnose spoiler failure on landing as brake failure," the report said. "The safety factors incorporated into landing performance calculations mean that in the event of a spoiler failure, an aircraft which touches down within the correct margins of speed, at the touchdown position, will stop before the end of the LDA [landing distance available], provided that appropriate braking effort is made by the flight crew."

Communication Faulted in Turbulence Event

Boeing 757-200. No damage. One serious injury, five minor injuries.

The airplane was near top of descent at Flight Level (FL) 400 (about 40,000 ft) during a flight with 104 passengers from New York to Los Angeles on April 12, 2007, when the flight crew received information about turbulence below 12,000 ft. "The captain advised the flight attendants to have the cabin secured and be in their seats within 15 minutes," said the report by the U.S. National Transportation Safety Board (NTSB).

The first officer gave the prepare-for-landing announcement as the 757 descended through FL 250. "In a written statement, the first officer said that turbulence departing New York had been very bad; therefore, in order to mitigate any passenger anxiety when he made the prepare-for-landing announcement, he added that the turbulence would not be as bad as it was on departure," the report said. "The flight attendants may have interpreted this added information concerning turbulence as a relaxation of the captain's earlier instructions."

None of the flight attendants was seated when the airplane encountered turbulence while descending through 15,500 ft, more than 15 minutes after the captain's advisory. The 757, on autopilot, was rolling out of a 12-degree banked turn. The turbulence lasted about 10 seconds; longitudinal and vertical acceleration spiked at about 2.0 g — that is, two times standard gravitational acceleration — and lateral acceleration varied between 0.10 g left and 0.05 g right.

All six flight attendants, but none of the passengers, were injured. After the airplane was landed, one flight attendant received medical treatment for a fractured fibula; the other flight attendants were treated for minor injuries.

NTSB said that contributing factors in the accident were "the apparent conflicting information provided by the flight deck to the flight attendants and the flight attendants' interpretation of that information."

Neglected Checklist Leads to Overrun

Bombardier CRJ100ER. No damage. No injuries.

While extending the landing gear during approach to Southampton (England) Airport the night of Jan. 17, 2007, the flight crew received indications of a failure of the no. 3 hydraulic system. "The commander took what he believed to be the necessary actions prior to landing but without apparent reference to the QRH [quick reference handbook]," the AAIB report said. "As a result, the aircraft landed with one of the no. 3 hydraulic system pumps still running and the nosewheel steering 'ON,' contrary to instructions in the QRH."

The copilot, the pilot flying, said that the CRJ touched down normally in the runway touchdown zone and aligned with the centerline. The ground spoilers deployed, and the copilot applied maximum reverse thrust and began to apply the wheel brakes. "The copilot steadily applied more pressure on the brake pedals but felt that the brakes were less effective than normal," the report said. "He stated that as the aircraft decelerated below about 70 kt … it began to veer to the right."

The copilot released pressure on the right brake pedal and applied full left brake and full left rudder. The commander also applied full left brake and rudder, and attempted to steer the aircraft with the tiller. "Despite this, the aircraft continued to veer to the right … and departed the runway onto the grass," the report said. Airspeed was about 50 kt when the CRJ ran off the right edge of the runway; it came to a stop about 16 m (52 ft) from the runway edge. None of the 36 occupants was injured.

Examination of the aircraft revealed a leak at the elbow joint of the outlet of one of the two pumps in the no. 3 hydraulic system. "An O-ring had ruptured, and the failure appeared consistent with a rapid loss of fluid," the report said. "A locking wire was missing between the pump and the elbow fitting, and either this or the incorrect installation of the O-ring appeared to be the cause of the failure."

Tests of the CRJ's nosewheel steering system showed that when hydraulic pressure decreased below the normal value, 1,650 psi, but not below 650 psi, the system steered slowly right at a rate of about 1 degree per second without any command input. "The pressure could be in this range after a hydraulic leak and with one, or both, of the no. 3 system pumps being 'ON,'" the report said. Below 650 psi, the nosewheel swiveled freely, as designed.

The report said that the hydraulic failure occurred more than two minutes before the CRJ touched down and that the incident would not have occurred if the crew had conducted the QRH procedures. However, if a hydraulic failure occurred just before touchdown, "it would be unreasonable to expect a crew to take the appropriate actions quickly enough to prevent a similar lack of controllability on the ground," the report said.

Based on this finding, AAIB recommended that Bombardier "review the design of the

"The aircraft landed with the nosewheel steering 'ON,' contrary to instructions in the QRH."

nosewheel steering system in the CRJ100 and other company products, to prevent uncommanded nosewheel steering following a hydraulic failure."

Mechanic Pulled Into Engine During Test

Boeing 737-500. Substantial damage. One fatality.

The flight crew saw a puddle of fluid under the right engine while preparing for a flight from El Paso, Texas, U.S., to Houston the morning of Jan. 16, 2006. A contract maintenance facility at the airport was asked to investigate the apparent oil leak, the NTSB report said.

There were 114 passengers and five crewmembers aboard the 737 when three mechanics opened the engine fan cowl panels and began the inspection. "The mechanics made a request to the captain, via a ground-to-cockpit intercom system, for an engine run to check for the leak source," the report said. "One mechanic positioned himself on the inboard side of the right engine, and the other mechanic on the outboard side of the engine. The third mechanic was positioned clear of the engine because he was assigned to observe the procedure as part of his on-the-job training."

The captain increased power after verifying with the mechanic that the area around the airplane was clear.

The flight crew started the engine and ran it at idle for about three minutes. One of the mechanics told the captain that a small oil leak was detected, and he asked the captain to run the engine at 70 percent power for two minutes so that further checks could be made. The captain increased power after verifying with the mechanic that the area around the airplane was clear.

"Witnesses on the ground and in the airplane saw the mechanic on the outboard side of the engine stand up, step into the inlet hazard zone and become ingested into the intake of the engine," the report said. "The mechanic was not wearing any type of safety equipment or lanyard to prevent the ingestion."

The mechanic, 64, had been a certified maintenance technician for 40 years. He had received training by the airline on on-call maintenance procedures but had not received specific training on ground engine runs and the associated hazards.

The report said that during interviews with the airline's maintenance technicians, "nearly all of the mechanics indicated that they never use lanyards and expressed concerns with quick release and escape during an emergency."

Ailerons 'Freeze' on Transatlantic Flight

Dassault Falcon 20. No damage. No injuries.

The Falcon was en route with five passengers from Little Rock, Arkansas, U.S., to London on May 9, 2007. During approach for a fuel stop in Gander, Canada, the pilot flying noticed that the ailerons were unusually stiff, said the AAIB report. After aileron trim was centered, roll control improved, and the commander believed that the cause of the stiffness was mistrimming of the ailerons.

About two hours after departing from Gander, the commander noticed a flickering "TRIM" indication on the primary flight display. "The commander applied corrective trim, in the required direction, but the caption reappeared from time to time," the report said. The commander used aileron trim several times when the aircraft, which was being flown on autopilot, began to drift off track.

The roll control problem worsened as the commander attempted to comply with air traffic control (ATC) radar vectors during the descent to London Stansted Airport. During a left turn, bank angle continued to increase; the commander disengaged the autopilot when bank reached 45 degrees. "He found that the roll control was very stiff when rolling to the right, and he used the rudder to bring the aircraft to a wings-level attitude," the report said. "Both pilots now applied force to the control wheel but were unable to move it."

The crew declared an emergency, advising ATC that they were able to make only shallow left turns. ATC then provided vectors that resulted in a series of left, 270-degree turns to position the Falcon for the instrument landing system (ILS) approach to Runway 23. "The commander was able to intercept and maintain the ILS course by using the rudder," the report said.

Surface winds were from 240 degrees at 16 kt, gusting to 25 kt, when the aircraft was landed safely. "Some 20 minutes after the aircraft had been shut down, the control wheel was still jammed," the report said. "The [copilot] carried out an external inspection of the aircraft and found that he could not move the ailerons either."

When the aircraft was inspected 36 hours later, the ailerons moved freely, and no system malfunctions were found. However, a large quantity of water was found below the cabin floor, in the area of the roll trim actuator assembly. "As a hand was dipped into the water in the area of the manual drain, the drain opened and water started to pour out onto the ground at a considerable rate," the report said. "It is estimated that at least 20 liters [21 qt] of water was drained from the aircraft."

The Falcon had rarely been operated on extended flights. The report said that the water likely had accumulated over a long period through a leaking cabin door seal and/or overflow from an icebox reservoir. "There appears little doubt that the [water] was responsible for the initial 'heavy' feel and subsequent freezing of the [aileron] controls," the report said.

After the incident, Dassault issued an urgent bulletin to Falcon operators, reminding them that fuselage drains must be checked before the first flight of the day.

TURBOPROPS

Fatigue Cited in Landing Undershoot

Fairchild Metro III. Substantial damage. One minor injury.

Daytime visual meteorological conditions (VMC) prevailed when the Metro struck a fence and terrain during approach to the airport in Grain Valley, Missouri, U.S., at 1551 local time on Aug. 17, 2006. The first officer received minor injuries.

The NTSB report said that fatigue was a contributing factor in the accident. The flight crew had been on duty nearly 19 hours and had conducted flights under the general operating and flight rules of U.S. Federal Aviation Regulations Part 91 and the commuter and on-demand operating rules of Part 135.

The captain told investigators that he was tired and that neither he nor the first officer had slept since reporting for duty at the company's base in El Paso, Texas, at 2030 the previous night.

The crew had conducted a Part 91 positioning flight to Ciudad Juárez, Mexico, where cargo was loaded for the return flight to El Paso. While taxiing for departure, however, the Metro's wing tip struck the wing tip of another airplane. "The [Metro's] wing tip was repaired using duct tape, and the flight then continued to ELP [El Paso]," the report said. The crew left the damaged airplane in El Paso and flew another Metro on a Part 135 cargo flight to Frankfort, Kentucky; a positioning flight to Knoxville, Tennessee; and a cargo flight to Tuscaloosa, Alabama. The flight from Tuscaloosa to Grain Valley was conducted under Part 91; the crew was to pick up parts needed to repair the Metro that had been damaged earlier in Ciudad Juárez and return to El Paso.

Jammed Power Levers Lead to Overrun

Dornier 328-100. Minor damage. No injuries.

Completing a flight from Stavanger, Norway, with 16 passengers on June 22, 2006, the copilot landed the aircraft at 105 kt and about 530 m (1,739 ft) from the approach end of Runway 34 at Aberdeen (Scotland) Airport. "The commander stated later that the touchdown was a little further along the runway than he would have preferred, but he considered it to be entirely safe," the AAIB report said.

With about 1,300 m (4,265 ft) of runway remaining, the copilot was unable to lift the latches on the power levers that allow the levers to be moved aft from the flight idle setting to select ground idle and reverse thrust.

The company operations manual specified that the power levers must be moved to the flight idle position before attempting to lift the latches. "There have been instances of premature lifting of these latches causing the power levers to become jammed," the manual said. The procedure for clearing a jam is to release the latches and move the power levers forward and then back to flight idle before attempting to lift the latches again.

The copilot conducted this procedure but again was unable to lift the latches. The commander then took control, applied heavy wheel braking and made four more attempts to clear the jam. The repeated power applications prevented the ground spoilers from deploying.

"As the aircraft approached the end of the runway, the commander steered the aircraft to the left to avoid colliding with the approach lights and localizer antenna on the extended runway centerline," the report said. The Dornier came to a stop about 350 m (1,148 ft) from the end of the runway.

The report discussed several previous incidents and a fatal accident — in Genoa, Italy, in February 1999 — involving the inability of flight crews to move the power levers aft from the flight idle position. After the Aberdeen accident, AAIB recommended that the European Aviation Safety Agency require the Dornier 328 type certificate holder to redesign the power lever latch system.

Servo Tab Separation Causes Control Loss

Viking Air DHC-3T. Substantial damage. No injuries.

The aircraft, a turboprop conversion of the de Havilland Canada Otter, was descending during a charter flight with five passengers from Broome, Western Australia, to Cone the morning of Feb. 15, 2006, when the pilot felt an unusual movement in the control system. The Turbo Otter then pitched down and entered a rapid and uncontrolled descent, said the ATSB report.

"With the assistance of the front-seat passenger, the pilot was able to arrest the descent and regain control of the aircraft before making a precautionary landing at Lombadina Station," the report said.

Investigators found that the outboard end of the right elevator servo tab had separated and entered a gross oscillatory movement, or flutter. "Aerodynamic flutter within the elevator trim and servo tabs of the DHC-3 aircraft type had been known since the 1960s; however, the development of turboprop engine conversions for the aircraft had resulted in an increased potential for tab failure," the report said.

An airworthiness directive (AD) issued by the U.S. Federal Aviation Administration in 2004 required modification of the DHC-3 tab assembly. Similar ADs became effective in Canada in March 2006 and in Australia in May 2006.

PISTON AIRPLANES

Gear Was Up When Propellers Struck Runway

Cessna 421B. Substantial damage. Two serious injuries.

The NTSB report said that the corporate pilot did not extend the landing gear during approach to Marathon, Florida, U.S., the morning of May 8, 2006. The pilot radioed that he was conducting an "emergency go-around." The report did not specify whether the landing was rejected before or after the propellers struck the runway.

The 421 climbed about 100 ft, then descended, struck utility poles and crashed in a saltwater canal. The pilot and passenger-pilot were seriously injured.

Examination of the airplane revealed "extensive torsional twisting and bending" of all six propeller blades, several of which had fractured or missing tips, the report said. The circuit breaker for the landing gear warning horn was found in the "pulled/tripped" position.

Elevated Cockpit Affects Sight Picture

Carvair ATL-98. Substantial damage. No injuries.

The flight crew was delivering a cargo of fuel bladders to a remote mining site near McGrath, Alaska, U.S., on May 30, 2007. During the landing flare, the right main landing gear separated when it struck the edge of the 4,200-ft (1,280-m) gravel runway. The right wing then struck the runway and separated from the fuselage, the NTSB report said.

The ATL-98 is a modified Douglas DC-4. The modification includes replacement of the forward fuselage with a large nose section comprising an elevated flight deck and a nose cargo door. The pilot told investigators that, because the sight picture during landing is higher in the Carvair than in the standard DC-4, "I think I was lower than I perceived."

Aerobatic Maneuver Overloads Airframe

Beech 58 Baron. Destroyed. Five fatalities.

The NTSB report said that after attending a recent air show, during which a Beech 18 was rolled by a performer, the pilot told acquaintances that he believed he could roll his Baron, which is not certified for aerobatic maneuvers. "He had previously attempted to roll the airplane, but a pilot-rated passenger stopped the accident pilot from completing the aerobatic roll," the report said.

On April 22, 2007, the pilot departed from Gulf Shores, Alabama, U.S., for a personal flight with four passengers. About an hour later, a witness heard sounds similar to an airplane in aerobatic flight and then saw the Baron descending in a 45- to 60-degree nose-down attitude at high speed. "The witness stated he observed a wing or part of the tail separate from the airplane," the report said.

The Baron struck terrain near Hamilton, Georgia. "Postaccident inspection of the airplane by the NTSB investigator-in-charge and the NTSB Materials Laboratory disclosed evidence of pilot-induced overload failures of the tail and wings," the report said.

HELICOPTERS

Normal Oil Temperature Was Deceptive

Bell 206L-3. Substantial damage. No injuries.

The helicopter was en route from La Tuque, Quebec, Canada, to Val-d'Or for a scheduled maintenance inspection the morning of June 7, 2006. About 20 minutes after takeoff, the pilot observed a fluctuating oil pressure indication and conducted a precautionary landing in a marsh, said the report by the Transportation Safety Board of Canada.

"After shutting down the engine, an unusual amount of bluish smoke was observed coming out of the exhaust pipe," the report said. The pilot telephoned a maintenance technician, who recommended that he check for oil leaks and sufficient oil quantity, and perform an engine run-up before contacting him again. While conducting the run-up, the pilot noticed that oil pressure was low but stable and that oil temperature was normal. Believing that the oil pressure indicator was defective, the pilot decided to fly the LongRanger to a road 1 km away. "It appears that the marsh's inaccessibility and the infestation of mosquitoes influenced the pilot's decision to move the helicopter to the road," the report said.

The LongRanger was about 50 ft above the road when the oil pressure and torque indications began to fluctuate. "Right after that, there was an explosion, and the engine failed," the report said. The rear portion of the skids contacted the ground during the autorotational landing, the helicopter pitched forward, and the main rotor severed the tail boom.

Examination of the engine revealed that the temperature of two of the nine bearings had exceeded 900 degrees C (1,652 degrees F) before the bearings were destroyed. "At this temperature, it is normal for oil to dissipate rapidly, by evaporation and burning," the report said. "The oil level became very low, causing the engine oil pump to cavitate and the engine oil pressure to fluctuate. Furthermore, since the oil did not return to the tank, the oil temperature did not change, or at least not significantly, and the pilot falsely deduced that the engine oil pressure gauge was displaying an incorrect indication." Because of the extent of damage to the two bearings, the cause of their overheating and failure was not determined.

Exhaust Duct Separates, Strikes Tail Rotor

Agusta A109A. Substantial damage. No injuries.

The helicopter was on a positioning flight from Redhill Aerodrome to pick up two passengers at Biggin Hill Airport in Kent, England, on Oct. 9, 2006, when the outboard exhaust duct on the left engine separated and struck the tail rotor, causing the tail rotor gearbox to separate.

"After an initial yaw to the right, the pilot regained limited control," said the AAIB report. "However, a further sudden yaw, possibly associated with a partial structural failure of the upper vertical stabilizer, prompted an immediate autorotative descent, which culminated in a successful forced landing."

The clamp that had attached the exhaust duct to the engine was found loose in the engine bay. The report said that the clamp failure was caused by a stress corrosion crack that could not have been detected visually or by nondestructive testing unless the clamp was removed. ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Feb. 1, 2008	Trinidad, Bolivia	Boeing 727-200	destroyed	159 none
En route from La Paz, the flight crew conducted a missed approach at Cobija because of adverse weather and diverted to Trinidad. An emergency landing, possibly due to fuel exhaustion, was conducted in a jungle clearing near the airport.				
Feb. 1, 2008	West Gardiner, Maine, U.S.	Cessna 525 CJ1	destroyed	2 fatal
Soon after departing from Augusta State Airport in freezing rain, the pilot declared an emergency and reported an attitude indicator failure. The CJ then crashed in a wooded area.				
Feb. 1, 2008	Mount Airy, North Carolina, U.S.	Raytheon King Air C90A	destroyed	6 fatal
Visibility was 2 1/2 mi (4,000 m), and ceilings were broken at 300 ft and overcast at 600 ft when the King Air crashed in a residential area during a missed global positioning system (GPS) approach.				
Feb. 5, 2008	South Padre Island, Texas, U.S.	Eurocopter AS 350B2	substantial	3 fatal
A local airport was reporting 8 mi (13 km) visibility and a 1,400-ft overcast when the emergency medical services helicopter crashed into the bay while maneuvering to pick up a patient.				
Feb. 7, 2008	Darwin, New South Wales, Australia	Boeing 717	substantial	84 none
The 717 entered a high sink rate on final approach and landed hard.				
Feb. 7, 2008	El Seibo, Dominican Republic	Britten-Norman Islander	substantial	9 NA
The crew conducted an emergency landing after an engine failed during a scheduled flight from Santiago de los Caballeros to La Romana. No fatalities were reported.				
Feb. 11, 2008	Atlantic Ocean	Cessna 310N	destroyed	1 fatal
The pilot ditched the 310 about 50 nm (93 km) from Keflavik, Iceland, during a ferry flight from Narsarsuaq, Greenland, to Reykjavik, Iceland.				
Feb. 12, 2008	Caracas, Venezuela	McDonnell Douglas DC-9	substantial	none
The unoccupied DC-9 apparently broke free while being towed from a hangar and crossed a runway before coming to a stop.				
Feb. 13, 2008	Sterling, Kansas, U.S.	Piper Aztec	destroyed	1 fatal
Daytime VMC prevailed when the Aztec crashed in an open field during a cargo flight from Wichita to Hays.				
Feb. 13, 2008	Los Roques, Venezuela	BAe Jetstream 31	substantial	16 NA
The airplane overran the runway on landing and came to a stop on the edge of a lagoon.				
Feb. 14, 2008	Yerevan, Armenia	Bombardier CRJ100ER	destroyed	21 minor
Calm winds were reported when the airplane flipped over and burned while departing for a scheduled flight to Minsk, Belarus.				
Feb. 16, 2008	Benton, Kansas, U.S.	Cessna 414A	destroyed	2 fatal
A 300-ft overcast and 6 mi (10 km) visibility were reported when the 414 struck trees and crashed soon after departing under visual flight rules for a positioning flight to Wichita.				
Feb. 18, 2008	Caico Seco, Venezuela	Cessna Citation III	destroyed	3 fatal
The Citation crashed in a field during a flight from Valencia to Puerto Ordaz.				
Feb. 21, 2008	Mérida, Venezuela	ATR 42-300	destroyed	46 fatal
The airplane struck a mountain soon after departing for a scheduled flight to Caracas.				
Feb. 22, 2008	Kayenta, Arizona, U.S.	Raytheon 1900D	substantial	2 serious, 3 minor, 15 none
The airport had 1 1/2 mi (2,400 m) visibility, a 400-ft overcast and 3 in (8 cm) of snow on the runway when the crew missed the first GPS approach. During the second approach, the 1900 touched down at midfield and overran the runway.				

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.