AeroSafety WORLD

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THE JOURNAL OF FLIGHT SAFETY FOUNDATION

SEPTEMBER 2007

China's Way

I recently have used this space to highlight issues that could threaten safety. This time I have the pleasure of highlighting an important example of how we can manage the challenges we are facing. While the rest of the world worries about how to maintain safety standards during a time of rapid growth, China is doing it a different way. China is holding safety as a constant, and letting the rate of growth be the variable.

Minister Yang Yuan Yuan, General Administration of Civil Aviation of China and last year's recipient of the Flight Safety Foundation–Boeing Aviation Safety Lifetime Achievement Award, is well aware of the challenges presented by his nation's economic success. As noted in a recent story that appeared on the Bloomberg newswire, China's passenger and cargo traffic grew 19.5 percent in the first half of 2007, faster than anticipated. "Our human resources and facilities can't support such fast growth," Yang told Bloomberg. "Our air traffic control and even the roads leading to airports are facing congestion."

At the end of 2006, China's airlines were flying 1,039 aircraft, double the size of the fleet in 1996 but only one-quarter of the 4,000 aircraft expected by 2020.

It is important to note that the regulatory system in China is very different. Minister Yang is not just a regulator of safety in the traditional sense. His authority extends to the economic regulation of the industry as well. But in this case, the point isn't about the extent of Yang's authority but rather what he is doing with that authority. He has made it clear that China's excellent safety record will be maintained or improved, and he is proactively limiting the rate of growth to make sure that happens.

While other countries passively observe the erosion of technical expertise in the system and worry about the impact, Yang has taken positive steps, such as raising pilot training standards and toughening the criteria pilots must meet to gain promotion to captain. His actions speak to the pressures on the pilot population, pressures that elsewhere may be producing insufficiently experienced and skilled cockpit crews. Yang stressed the importance of skill and experience through the story of how the nose gear of a 767, being boarded in Beijing, collapsed due to a crew mistake; most of the staff involved in the incident were trainees.

About a decade ago, China was looking at its first experience with prolonged vigorous economic expansion and a booming aviation travel market. When several accidents highlighted the stresses on the system, Chinese regulators pulled in the reins, slowing growth and renewing their emphasis on safety. It is no coincidence that, following that action, China has not had an air carrier accident since 2004.

Vigorous economic and aviation system growth requires a coordinated ramp-up of infrastructure, including people, airports and air traffic control. This coordinated response doesn't manage itself. It must be controlled by an autonomous regulatory body that has the authority to act and the resources to follow through on those actions. That is what we are seeing in China. It has worked in the past, it will ensure safety in the future, and it reminds us what needs to be done to ensure safety in other places around the world. China's way may not be the answer in every detail for everybody, but I believe much can be learned from its experience.

William R. Voss
President and CEO
Flight Safety Foundation

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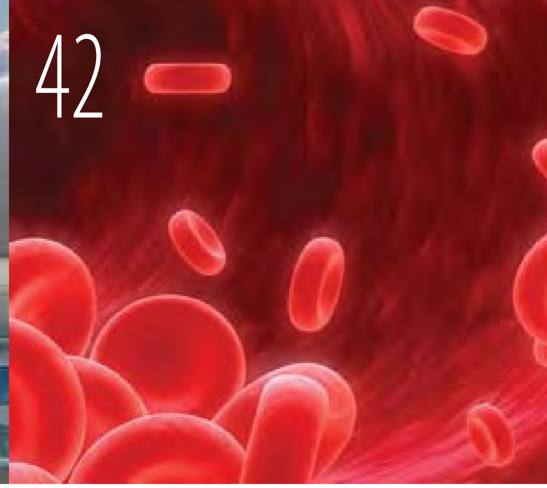

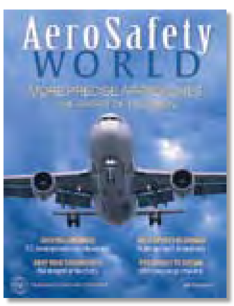

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More precise approaches can be flown with existing equipment.
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Serving Aviation Safety Interests for More Than 50 Years

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 1,000 member organizations in 142 countries.

Member**Guide**

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THE AIRPORTS' Tale

The odds against the U.S. Federal Aviation Administration (FAA) getting all of the funding it needs to quickly implement the NextGen air traffic control (ATC) system are long, indeed (p. 12). Anyone doubting this assessment should look at the history of the two Washington, D.C., airports for precedent.

A native of the Washington area, I have a good memory of the airports' histories. My first airplane ride was a DC-4 out of Washington National (DCA), and shortly after Washington Dulles (IAD) opened, my friends and I found that the echoing terminal of the underutilized airport was a fun place to spend a day cutting classes.

They were the only two civil airports in the United States owned and operated by the federal government. While the FAA was the official operator of the airports, Congress held the purse strings and therefore had the power to specify exactly what happened, or didn't happen, at the airports.

And what didn't happen in either place was any meaningful development, badly needed even before deregulation triggered robust traffic growth. DCA, built on landfill in the Potomac River in the late 1930s, had cramped terminals designed for DC-3s. And IAD's central design concept of using mobile lounges as both boarding gates and airplane loaders quickly was shown to be seriously flawed.

Despite the desperate need for action at both airports, and the offer of numerous plans to fix the problems, Congress was unable to make any meaningful progress, frozen by a slew of conflicting interests and heavily influenced by representatives from local jurisdictions whose voters were vocal in their objection to anything that could be seen as possibly allowing growth — especially for close-in DCA — bringing increased noise and pollution.

Congress accomplished one thing, however. At DCA, it built a VIP car parking lot for use by members of Congress and Supreme Court justices, just steps away from the main terminal. At least that was cheap.

It wasn't until 1987 that Congress finally was shamed into transferring both airports to a regional airport authority. Even then, Congress tried to maintain some control through an arrangement that eventually was thrown out by the courts.

Put into the hands of professional airport managers with independent access to funding on the same basis as other airports, both facilities blossomed. DCA is the very model of the easy-access, modern airport, pleasant to use and great to look at. IAD is still working toward its long-term layout, but it, too, is much improved.

Blame for slow progress in reshaping the U.S. ATC system is laid on the FAA, which, it must be admitted, is not faultless. However, system funding is far beyond its control.

First, it must run the federal budget development gauntlet, where the agency needs are subject to conflicting priorities even though most of the bills will be paid by system users. Then the agency's needs are put before the 535 micro-managers on Capitol Hill. As the saga of the Washington airports illustrates, this is not a recipe for success.

The airports' success was made possible when Congress dropped out of the money loop, a tale that might be useful in considering ways to accelerate the capacity and safety advances of NextGen.

J.A. Donoghue

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

Ramp Workers Contributed to Evacuation After Collision

Congratulations on placing *AeroSafety World* online for the entire world to read, a prodigious step forward in the distribution of safety knowledge.

Mark Lacagnina's article titled "No Brakes, No Steering" (*ASW*, 7/07, p. 33) illuminated the human factors cause of this accident but unfortunately stopped short of telling the entire story.

Even before the aircraft rescue and fire fighting crew arrived, Northwest Airlines personnel (mechanics) lodged a tug against the DC-9's nose and attempted to rescue the pilots, who were trapped in the cockpit, through a cockpit window. Likewise, they tried to enter the fuselage through the forward galley door to effect a rescue. Additional NWA personnel dropped the rear airstair (which can only be deployed from the ground), and passengers were calmly directed across the ramp to safety.

Later in the event, the decision was made to evacuate the A319 due to the continuing leaking of jet fuel from the A319's ruptured wing, causing concern by ARFF that the fuel would find an ignition source. The crew deployed the forward slide, and NWA ground personnel caught the passengers as they evacuated and guided them to safety in the terminal building.

It is important to remember that, in this event, the DC-9 pilots were trapped, injured and out of the game. The A319 pilots had no idea what had happened to them. There were no particular "leaders" of the evacuation on the ground, rather a group of trained individuals who instinctively took action to ensure the safety of the passengers.

In no way do I mean to demean the training or ability of ARFF personnel. Rather, the point is that, in the development of rescue plans, the airline personnel who routinely handle these various aircraft are much quicker to react. They should be an integral part of any airport disaster/rescue plan. And the ramp personnel in this accident should receive a "tip of the hat" for their actions.

Paul Eschenfelder
Avion Corp.

Controllers Have a Part to Play in ATC Modernization

I would like to respond to the editorial "Poisonous" (*ASW*, 7/07, p. 5), which partially described the angst that exists between air traffic controllers and the U.S. Federal Aviation Administration. In your editorial, you claimed that the two sides are talking past each other and that the future of the air traffic control system is at stake unless the two sides start communicating better. We agree completely, as does the Government Accountability Office, which told Congress in May that the FAA, by failing to involve controllers in technology development, incurs costly reworks and delays. The GAO further reported that, to its dismay, no current controllers or technicians are involved at the more detailed group planning levels for the next generation air traffic system.

Nobody wants to modernize the U.S. air traffic control system more than this nation's air traffic controllers. We have long been proud to lend our expertise to ensure that the FAA's modernization efforts are safe and effective. From 1997 to 2002, controllers worked closely with the FAA, conducting tests, developing equipment and methods, and then successfully implementing new equipment and procedures.

However, current FAA leadership has not been as open to accepting National Air Traffic Controllers Association assistance. Our technical experts have been sent home, and the FAA has refused our requests to be involved in the modernization. Even with this setback, controllers continue to be eager to help design and implement NextGen.

You also mentioned our nearly daily barrage of press releases alleging one safety problem after another. In fact, NATCA issued 21 press releases total throughout May, June and July, some of which detailed serious safety issues concerning the ATC system. As those with a front-row seat on how safely the system is operating daily, we feel it is our civic and moral responsibility to blow the whistle on all important safety issues in order to protect the flying public. It would not do anybody any good if we stood back and said nothing at all.

The U.S. air traffic system is the best in the world. Controllers are hard at work 24 hours a day, seven days a week, to ensure that your loved ones arrive safely at their destinations.

Patrick Forrey
National Air Traffic Controllers Association

SEPT. 3–6 ➤ Asian Aerospace 2007. Reed Exhibitions. Hong Kong. <www.asianaerospace.com/index.html>, +852 2824 0330.

SEPT. 5–6 ➤ 19th FAA/ATA International Symposium on Human Factors in Maintenance and Ramp Safety. U.S. Federal Aviation Administration and Air Transport Association of America. Orlando, Florida, U.S. <ata@airlines.org>, <www.airlines.org/operationsandsafety/events/2007+HF+Symposium+Web+site.htm/>, +1 202.626.4000.

SEPT. 10–13 ➤ Bird Strike 2007 Conference. Bird Strike Committee Canada and Bird Strike Committee USA. Kingston, Ontario, Canada. Carol Liber, <events@theplanner.net>, <www.birdstrikecanada.com/2007conf.htm>, +1 604.276.7471.

SEPT. 11–15 ➤ 17th ACI Africa Annual Assembly, Regional Conference and Exhibition. Airports Council International. Arusha, Tanzania. <events@aci-africa.aero>, <www.aci-africa.aero/en/index.php?idp=4&>.

SEPT. 11–12 ➤ Crisis Management for the Aviation Industry. Quaynote Communications. London. <info@quaynote.com>, <http://www.quaynote.com/ankiti/www/?code=uk13&f=home>, +44 (0)207 074 0241.

SEPT. 12–13 ➤ CFIT/Approach and Landing Action Group ALAR Workshop. Flight Safety Foundation and Flight Safety Foundation International. Baku, Azerbaijan. Farkhan Guliyev (Baku), <farkhan.guliyev@azans.az>, +99 450 333 20 30; Rafail Aptukov (Moscow), <fsfi@fsfi.civilavia.ru>, +7 495 155 6869; Jim Burin (United States), <burin@flightsafety.org>, +1 703.739.6700, ext. 106.

SEPT. 13 ➤ De/Anti-Icing Seminar. National Air Transportation Association. Denver. <www.nata.aero/events/event_detail.jsp?EVENT_ID=1021>.

SEPT. 16–20 ➤ 55th International Congress of Aviation and Space Medicine. International Academy of Aviation and Space Medicine. Vienna, Austria. <icasm2007@imperial-tours.com>, <www.icasm2007.org/>, +43 1 535 69 70.

SEPT. 17–19 ➤ Air Medical Transport Conference. Association of Air Medical Services. Tampa, Florida, U.S. Natasha Ross, <nross@aams.org>, <www.aams.org/Content/NavigationMenu/EducationMeetings/AMTC2007/default.htm, +1 703.836.8732.

SEPT. 17–19 ➤ 8th Annual Aviation Industry Suppliers Conference. SpeedNews. Toulouse, France. <conferences@speednews.com>, <www.speednews.com/Conference/euroconference.html>, +1 310.203.9603.

SEPT. 17–19 ➤ World Low Cost Airlines Congress. Terrapinn. London. Caroline Thoresen, <Caroline.Thoresen@terrapinn.com>, <www.terrapinn.com/2007/wlca/Custom_16556.stm>, +44 (0)207 092 1230.

SEPT. 19–21 ➤ Russian International Business Aviation Exhibition. JetExpo. Moscow. <info@jetexpo.ru>, <www.jetexpo.ru>, +7 495 739 55 22.

SEPT. 19–22 ➤ 12th Aviation Expo/China 2007. General Administration of Civil Aviation of China. Beijing. <www.cpexhibition.com/aviation/aviation.html>.

SEPT. 25–27 ➤ NBAA2007: Helping Businesses Take Flight. National Business Aviation Association. Atlanta. Donna Raphael, <drapahel@nbaa.org>, <web.nbaa.org/public/cs/amc/2007>, +1 202.478.7760.

SEPT. 25–28 ➤ ION GNSS 2007. Institute of Navigation Satellite Division. Fort Worth, Texas, U.S. <www.ion.org/meetings/#gnss>, +1 703.383.9688.

SEPT. 26–27 ➤ 7th Annual CIS, Central and Eastern European Airline Engineering and Maintenance Conference. Aviation Industry Group. Prague, Czech Republic. Ruth Martin, <ruthm@aviation-industry.com>, <www.aviationindustrygroup.com/index.cfm?pg=247&archive=false&offset=1>, +44 (0)207 931 7072.

OCT. 1–2 ➤ UKFSC Annual Seminar: Technical Innovation and Human Error Reduction. U.K. Flight Safety Committee. Heathrow. <admin@ukfsc.co.uk>, <www.ukfsc.co.uk/annual%20seminar.htm>, +44 (0)1276 855193.

OCT. 1–4 ➤ 60th annual International Air Safety Seminar. Flight Safety Foundation, International Federation of Airworthiness, and International Air Transport Association. Seoul, Korea. Namratha Apparao, <apparao@flightsafety.org>, <www.flightsafety.org/seminars.html#iass>, +1 703.739.6700, ext. 101.

OCT. 2–4 ➤ Helitech 2007. Reed Exhibitions. Duxford/Cambridge, U.K. Sue Bradshaw, <sue@helitech.co.uk>, <www.helitech.co.uk/>, +44 (0)20 8439 8894.

OCT. 8–11 ➤ Flight Simulator Engineering and Maintenance Conference. ARINC. Montreal, Quebec, Canada. Sam Buckwalter, <sbuckwal@aric.com>, <www.arinc.com/fsemc>, +1 410.266.2008.

OCT. 10–14 ➤ CAMA Annual Scientific Meeting. Civil Aviation Medical Association. San Diego. James L. Harris, <Jimlharris@aol.com>, <www.civilavmed.com/Meeting_Events.htm>, +1 405.840.0199.

OCT. 15–16 ➤ European Aviation Training Symposium. Halldale Media Group. Berlin. Chris Lehman <chris@halldale.com>, <www.halldale.com/eats>, +44 (0)1252 532000.

OCT. 15–19 ➤ Accident Investigation Orientation for Aviation Professionals. U.S. National Transportation Safety Board. Ashburn, Virginia, U.S. <TrainingCenter@ntsb.gov>, <www.ntsb.gov/Academy/CourseInfo/AS301_2007.htm>, +1 571.223.3900.

OCT. 15–19 ➤ Survival Factors in Aviation Accidents. U.S. National Transportation Safety Board. Ashburn, Virginia, U.S. <TrainingCenter@ntsb.gov>, <www.ntsb.gov/Academy/CourseInfo/AS302_2007.htm>, +1 571.223.3900.

OCT. 16 ➤ All Clear? The Path to Clear Communication ToolKit Workshop. Eurocontrol. Brussels. Leila Ikan, <leila.ikan@eurocontrol.int>.

OCT. 16–18 ➤ Aviation (Asia) Fire Conference 2007. International Aviation Fire Protection Association. Singapore. <iafpa2007conference@yahoo.com.sg>, <www.iafpa.org.uk/conference/Singapore/>, +65 6541 2523.

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

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

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

Safety News

Improvements Sought in Maintenance Oversight

The U.S. National Transportation Safety Board (NTSB), citing maintenance problems that preceded the Dec. 19, 2005, fatal crash of a Grumman Turbo Mallard G-73T, has recommended actions to verify that maintenance programs address recurring or systemic discrepancies.

The NTSB recommended that the U.S. Federal Aviation Administration (FAA) "verify that the maintenance programs of commercial aircraft operators include stringent criteria to address recurring or systemic discrepancies, including, if necessary, further analysis of the discrepancies through a comprehensive engineering evaluation."

A second recommendation said that the FAA should "identify the systemic deficiencies in the maintenance program oversight procedures that led to [the 2005] accident and modify those procedures to ensure that the maintenance program plans for commercial operators are adequate to ensure the continued airworthiness, both structural and otherwise, of the operator's fleet."

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The accident occurred when a Chalk's Ocean Airways amphibious airplane struck the water in a shipping channel adjacent to the Port of Miami after takeoff from the Miami Seaplane Base for a flight to Bimini, Bahamas. All 20 people in the airplane were killed, and the airplane was destroyed.

The NTSB said that the probable cause of the crash was the "in-flight failure and separation of the right wing during normal flight." The failure resulted from "the failure of the Chalk's Ocean Airways maintenance program to identify and properly repair fatigue cracks in the right wing and the failure of the … FAA to detect and correct deficiencies in the company's maintenance program," the NTSB said.

New Navigation Options

Researchers are seeking options for the introduction of safer instrument navigation systems using global navigation satellite system (GNSS) approaches with vertical guidance.

The Civil Aviation Safety Authority of Australia (CASA) has commissioned a study to identify the best and most affordable technology for the approaches, which will incorporate vertical guidance into information already available from the GNSS.

© Garmin

"The major airlines with the advanced navigation technologies of their new generation aircraft … are already using this type of approach around Australia and overseas," said Ian Mallett, a CASA navigation systems specialist. "It is now time to make vertical guidance available to anyone with the technology in their aircraft and the training to fly using the instruments."

The International Civil Aviation Organization (ICAO) and Flight Safety Foundation have said that approaches with vertical guidance are seven or eight times safer than straight-in approaches without vertical guidance (see related story, p 20).

Study results, expected in about six months, will be shared with the international aviation industry, CASA said.

Runway Assignment

The Airbus A380 will be permitted to operate on standard-width runways of about 150 ft/45m in the United States, the U.S. Federal Aviation Administration (FAA) says. The European Aviation Safety Agency (EASA) issued a similar decision late in 2006 (*ASW*, 7/07, pp. 46–49).

James J. Ballough, director of the FAA Flight Standards Service, told Airbus in a letter dated July 19, 2007, "This aircraft has been shown to be safely controllable and to be compliant with applicable airworthiness requirements when operating on runways with a width of 45 meters (150 feet) or more."

Airbus said that the FAA's approval was a result of "a unique operational evaluation, including airport compatibility checks, route-proving campaigns and dedicated flight-testing together with the authorities."

New Push for Safety

Indonesia has agreed to restructure its Directorate General of Civil Aviation as part of an effort to achieve quick and wide-ranging improvements in its civil aviation system.

In an agreement with the International Civil Aviation Organization (ICAO), Indonesia also pledged to enact legal measures to better comply with international safety obligations, to ensure that the required human and financial resources are available to implement the improvements, and to correct aviation safety deficiencies identified by ICAO and other organizations.

"There is an urgent need to implement a concrete, realistic and achievable plan of action," said ICAO President Roberto Kobeh González.

The agreement also calls for Indonesia to implement a "proactive and systemic management of safety" to comply with national and international safety standards and industry best practices, ICAO said.

Several major aviation accidents have occurred in Indonesia in recent months, and the U.S. Federal Aviation Administration — in a study commissioned by the Indonesian government — has said that the Indonesian Directorate General of Civil Aviation is not in compliance with ICAO aviation safety standards for oversight of air carrier operations.

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Bird Strike Study

Aircraft operated by Taiwan-based airlines were involved in 1,009 reported bird strikes from 2002 through 2006, according to a report by Flight Safety Foundation–Taiwan.

Of that number, 125 strikes caused damage to the aircraft, and 26 resulted in "abnormal situations" in which flight crews were forced to return to the departure airport, reject a takeoff or conduct an emergency landing, the report said. Eighty-two of the 1,009 incidents occurred outside Taiwan but involved aircraft operated by Taiwanese companies.

The greatest number of bird strikes reported in a single year was 237, reported in 2003. The lows were 138 strikes, reported in 2005, and 151 strikes, reported in 2006.

More TAWS Training Urged

Flight crews of Airbus A320s should be reminded periodically of the necessity for an immediate response to any warning from a terrain awareness and warning system (TAWS) during "instrument flight or flight in difficult weather conditions or flight in the mountains," said the final report on the May 3, 2006, crash of an A320 into the Black Sea.

The report by the Air Accident Investigation Commission of the Interstate Aviation Committee said that civil aviation authorities of countries within the Commonwealth of Independent States should ensure that the reminders are delivered to A320 crews through training exercises. The authorities also should consider extending the recommendation to crews of other types of aircraft, the report said.

Another of the nearly two dozen recommendations called for the aviation authorities and industrial and scientific research groups to "organize and conduct research into the conditions under which a crew may lose spatial orientation and/or upset aircraft attitude may develop, and to issue practical recommendations to enhance flight safety." The recommendation said that the research should emphasize the evaluation of illusions related to in-flight acceleration.

The A320, operated by Armavia, was destroyed and all 113 occupants were killed in the crash in Sochi, Russia, following a flight from Yerevan, Armenia. The crash occurred as the crew conducted the missed approach segment of an instrument landing system approach and attempted a climbing maneuver in night instrument meteorological conditions below the established minimums for the landing runway.

The investigation commission said that the captain's incorrect control inputs resulted in an "abnormal situation" and that his subsequent actions "were insufficient to prevent development of the abnormal situation into the catastrophic one."

© Airbus S.A.S.

Cautious Footwork

Embraer Legacy pilots risk inadvertently placing their transponders in standby mode during flight if they bump them while placing their feet on a footrest just below the instrument panel, the U.S. Federal Aviation Administration (FAA) says.

In Safety Alert for Operators (SAFO) 07005, the FAA said that pilots might not notice the corresponding standby indication on the pilot flight display, which would be indicated in white letters, which are "not as noticeable as differently colored caution or warning indications."


© Embraer S.A.

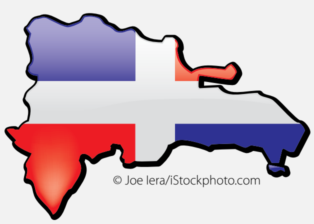
The FAA said that an inadvertent change in VHF radio frequencies also might result from a pilot's foot contacting the radio management unit.

"Switching a transponder with a functioning traffic-alert and collision avoidance system (TCAS) to standby mode renders the TCAS ineffective," the SAFO said. "Two airplanes equipped with TCAS would fail to see each other if they were on a collision course. Pilots could presume TCAS was operating normally if they failed to notice the subtle "TCAS OFF" indication on the pilot flight display."

The safety alert recommended that training centers and operators ensure the pilots are aware of the hazard, which the FAA said was discovered during an investigation. The SAFO did not mention the subject of the investigation.

In Other News …

The U.S. Federal Aviation Administration, which audits civil aviation authorities worldwide for compliance with International Civil Aviation Organization safety standards, has raised the safety rating for the **Dominican Republic** to Category 1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— in compliance. … More than half of all accidents involving private airplane operations in **Australia** during a five-year period occurred during the landing phase, a study by the Australian Transport Safety Bureau says. In comparison, helicopter accidents were distributed fairly evenly among takeoff, cruise, maneuvering and landing phases. … The **European Civil Aviation Conference**, in its annual Safety Assessment of Foreign Aircraft (SAFA) report, says that during 2006, 34 European member states conducted 7,458 ramp inspections of 822 operators from 127 states. The report says that, although the average number of findings per inspection increased in 2006, the increases were in items considered minor findings and were accompanied by decreases in the number of significant and major findings.

Icing Rules

New airworthiness standards for performance and handling characteristics of transport category airplanes in icing conditions will take effect for U.S. transport category airplanes in October.


U.S. National Aeronautics and Space Administration

The U.S. Federal Aviation Administration (FAA) published its final rule on the subject on Aug. 8, 2007; the rule takes effect Oct. 9.

The FAA said that the action is designed to "improve the level of safety for new airplane designs when operating in icing conditions and [to harmonize] the U.S. and European airworthiness standards for flight in icing conditions."

Compiled and edited by Linda Werfelman.

SEEKING GUIDANCE

BY WILLIAM SHUMANN

Those running the quest for new generation ATC systems are fighting to overcome political problems, not technical problems.

Airlines clearly believe numerous forecasts of strong traffic growth over the next 20 years; the number of airplanes on order is proof of that, an order surge mirrored by corporate operators. But unanswered is how air traffic control (ATC) systems in Europe and the United States, already straining at the seams, will be able to handle the onslaught, and do so with an increased level of safety.

Politics present the biggest obstacle to implementing a well-defined technology solution in both the United States and Europe. The nature of the problem in each place, however, is vastly different.

Both regions have numerous unambiguous predictions of the looming crunch, with variations just in the degree of the challenge. In Europe, Eurocontrol expects the number of flights to double — from 10.5 million in 2005 to 21 million in 2025. In the U.S., the Federal Aviation Administration (FAA) estimates that the growth in revenue passenger miles will increase by as much as 1.8 to 2.4 times during the 2004–2025 period.

Adding to this range of uncertainty (Figure 1, page 14) is the unclear future mix of aircraft; the United States jet airline fleet, FAA estimates, will grow from just under 4,000 in 2006 to 6,000 by 2020. Will airlines continue to shift flights to smaller jets, meaning more aircraft movements to carry the expected number of passengers? How popular will the new very light jets prove to be for business travelers? How will ATC systems accommodate unmanned aerial vehicles, and how many will there be? What impact will the Airbus A380 have on traffic flow?

J.A. Donoghue

The political problems ATC modernization faces in Europe and the United States are much more complex and daunting than the technical issues, exacerbated by the assumption of many that any new-generation ATC system should improve safety along with capacity; the stated goal in Europe is to handle double the traffic while cutting the accident rate in half.

In the United States, Congress, the FAA, airlines and general aviation have been embroiled this year in debate over reauthorization legislation for the agency's budget for the next five years. The legislation sets program guidelines, general spending limits and, more importantly, the taxes that fund a large portion of the FAA. This year, the government and the airlines began by advocating a switch from taxes on airline passenger tickets and fuel to a system of fees paid by ATC users, similar to what is done in Europe, Canada and elsewhere. The general aviation organizations' vehement opposition to the change made it unlikely Congress will approve a new tax system by the expiration of the current system at the end of September.

Regardless of how much Congress agrees to spend on the FAA's five-year plan, the agency's programs are vulnerable to annual funding fights with Congress, during which money may be increased, cut or reallocated for whatever programs that Congress chooses. But even before it starts trying to convince Congress of its needs, the FAA must contend with conflicting demands for resources during the administration's budget development process.

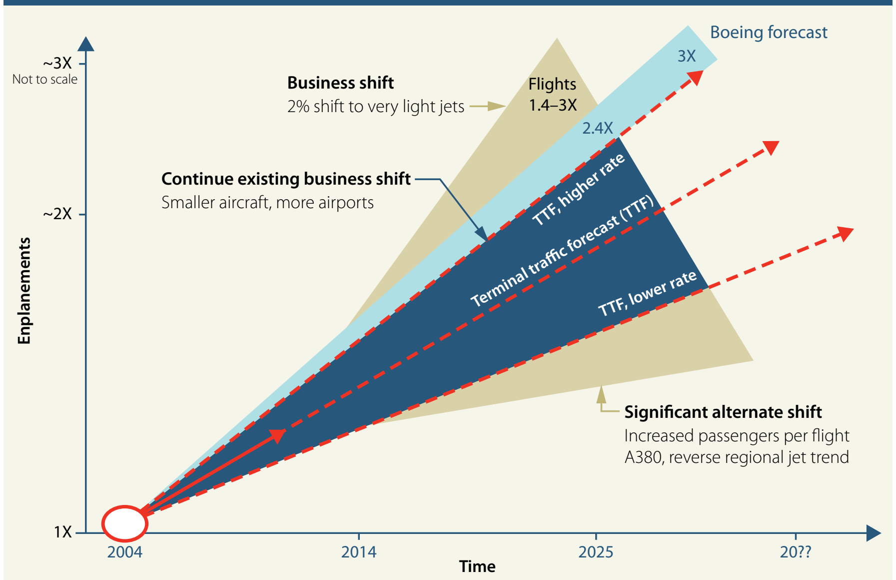
Europe's air navigation service providers (ANSPs) have a much different financial situation, receiving a steady stream of funds from user fees and other charges imposed on those who fly, and from the European Commission and other government agencies. "We don't have a (financial) resource problem," says Bo Redeborn, Eurocontrol's director of air traffic management strategies.

But Europe does have a well-known problem absent in the United States — fragmentation. There are 27 nations in the European Union (EU) and 38 in Eurocontrol. Virtually all Eurocontrol members jealously guard their own airspace, ANSPs, regulations, equipment and procedures. Further complicating the situation is the amount of airspace set aside for military operations in many countries, distorting air traffic flows.

U.S. Federal Aviation Administration

FAA is running out of room to increase the number of sectors (below) as a method of dealing with booming hub traffic growth (left).

Airspace System Demand Forecast



Source: U.S. Federal Aviation Administration

Figure 1

As Alexander ter Kuile, secretary-general of the Civil Air Navigation Services Organisation (CANSO), an organization of ANSPs, put it in a July letter to *The Economist*: "In Europe, aircraft are transferred between control centers that seem to be allocated on the basis of the 1648 Treaty of Münster, with no regard to operational efficiency … . Governments must address this problem for the good of the system."

The European Commission started addressing it as early as 1999, when Loyola de Palacio, European transport commissioner at the time, proposed the Single European Sky (SES). The need for it is clear — Europe has 50 en route air traffic control centers; the European Commission estimates the system is half as efficient as the U.S. ATC en route system, which has 20 centers in the contiguous 48 states, plus centers in Alaska, Hawaii, Puerto Rico and Guam. Eurocontrol's Performance Review Commission says the lack of a united European sky costs the economy 3.3 billion euros (US$4.5 billion) annually in airline and society losses, including things like passengers' time stuck in airplanes.

In 2004, EU members and their ANSPs agreed to work together to develop functional airspace blocks (FABs), multinational volumes of high-altitude airspace to simplify traffic flows. For example, the Northern Upper Area Control FAB would include the airspace of Denmark and Sweden, and possibly that of Estonia, Finland and Norway.

The FABs were supposed to be developed by the end of 2008. However, no one now believes that target will be met. The airlines, led by International Air Transport Association, are decrying the lack of progress, blaming some countries for refusing to give up sovereignty over their airspace and calling for more leadership from the European Commission.

The ANSPs reply that developing FABs is more complex than anyone predicted. Ter Kuile argues that FABs involve highly complex national, institutional and military issues about who should control and use the airspace. Among the complexities are different ATC philosophies, technologies and even definitions of basic terms.

Eurocontrol's Redeborn agrees that the expectation of FABs as a solution to the fragmentation of European airspace "is overblown" and not as easily achieved as the political authorities believed. There are no guidelines for dealing with the legal, institutional and liability issues in the Netherlands, he adds. The only current FAB is Eurocontrol's long-standing Maastricht center, which controls the high-altitude airspace over the Benelux nations and part of northern Germany. Redeborn believes that it's possible to reduce the numbers of ANSPs and ATC centers without relying solely on FABs by using other initiatives, such as a common ground communication system or expanding the Maastricht airspace. He is "not disappointed at all" in the slow progress with FABs and believes that 2012–2015 is a more realistic time frame in which European airspace will be less fragmented and better-managed.

Last November, EU Transportation Commissioner Jacques Barrot appointed a high level group (HLG) to examine what is delaying the SES. The 10 members included the heads of three civil aviation authorities and senior executives representing the airlines and other users, airports, ANSPs and Eurocontrol. Among the 10 recommendations the HLG produced was a call for the EC to address hurdles to achieving the SES and to draw up a framework for new economic regulation of ANSPs, providing incentives for them to improve performance without jeopardizing safety.

The HLG report said, "In the evolution of the Eurocontrol organization" responsibilities seem to be shifting; the HLG "supports the integration of the operations of the Maastricht Upper Area Control Centre into the relevant FAB under governance arrangements as defined by the states responsible. These states should strive to have the new arrangements in place as soon as possible and no later than 2012." These "new arrangements" may shift responsibilities outside the traditional Eurocontrol organization.

While Europe continues struggling to create a unified ATC system, the United States is attempting to move its unified system into new technology that can cope with the rising demand for air travel by shifting from ground-based aircraft surveillance and separation to space- and aircraft-based surveillance and separation. Originally known as the Next Generation Air Transportation System (NGATS), now it is simply called NextGen.

"At the FAA, there's nothing more important than NextGen," FAA Administrator Marion C. Blakey said in July.

What the FAA calls "a unique public/private partnership," the Joint Planning and Development Office (JPDO), is charged with planning and implementing NextGen through 2025. The JPDO includes representatives from the departments of Commerce, Defense, Homeland Security and Transportation, the White House Office of Science and Technology Policy, the FAA and the National Aeronautics and Space Administration, with the last two providing most of the staff. It also has a number of working groups that include representatives of the various stakeholders outside government such as airlines, airports, aerospace companies, general aviation groups and unions.

As evidence of the progress being made, JPDO Director Charles A. Leader cited three key documents that were released this summer:

- ***Concept of Operations:*** Version 2.0 describes the full scope of NextGen operations and how they will affect various stakeholders. It emphasizes the importance of developing the structure, policies and procedures to make NextGen a reality;
- ***Enterprise Architecture:*** Similar to a set of blueprints, it defines the key capabilities

The 38 Eurocontrol nations (below) manage European airspace with 50 en route control centers (bottom).

Susan Reed

Eurocontrol

Eurocontrol

of NextGen and how they will be integrated. It is synchronized with the Concept of Operations; and,

- ***Integrated Work Plan:*** This document complements the first two by providing the programmatic and funding details of the transition to NextGen.

Leader emphasized that there is "no gee-whiz technology in NextGen." What it will require is a great quantity of software and a new information technology (IT) infrastructure for implementation over a period of almost 20 years. Three key IT programs will be launched later this year or early in 2008, Leader said. They are:

- ***Systemwide Information Management:*** An FAA system similar to the Defense Department's Global Information Grid, it will provide communications throughout the FAA and between it and other agencies;
- ***Data Communications:*** Providing data-link communications between aircraft and controllers, this system has two key benefits, Leader believes: "deconfliction of trajectories," where controllers will spot aircraft route conflicts and resolve them more efficiently, and better utilization of special use airspace, now reserved for military use; and,
- ***Next-Generation Network-Enabled Weather:*** Using the first two new IT programs to provide four-dimensional weather information to pilots and controllers, adding time to the other three dimensions. This system will involve the National Weather Service, U.S. Air Force, U.S. Navy and the FAA. It should produce a major reduction in the 70 percent of airline delays caused by bad weather, Leader said. One issue to be resolved later, he added, is what portion of the costs each service will pay.

However, some issues remain to be dealt with, according to the Government Accountability Office (GAO), the investigative agency of Congress.

In reports and congressional testimony this spring, GAO pointed to the "leadership gap" facing the FAA. Blakey's five-year term ends in September, and, at press time, President George W. Bush had not named a successor. When Bush, a Republican, makes his pick, that person must then be confirmed by the Democratic-controlled Senate. Either a lack of a nomination or a political logjam in the Senate could produce a leadership vacuum when Blakey leaves. Also, the chief operating officer of the FAA's Air Traffic Organization (ATO), of which the JPDO is a part, left in February and has not been replaced.

Leader is relentlessly optimistic, saying that Blakey's strong initiative and focus on NextGen, bipartisan support in Congress and the backing of the concept from the aviation industry have given the program "so much momentum" that it will survive a gap between FAA administrators. He expects a new head of the ATO to be named shortly.

In contrast, Eurocontrol announced in early July that David McMillan, now director general of civil aviation in the United Kingdom, will succeed Victor M. Aguado as Eurocontrol's director general on Jan. 1, when Aguado's seven-year term ends.

The GAO also cited the need for the JPDO to seek greater involvement of all the stakeholders, particularly the air traffic controllers. Leader agrees with GAO that NextGen will change the role of the controllers as they shift from controlling specific aircraft to managing air traffic flows. He said that members of the National Air Traffic Controllers Association (NATCA) are involved in NextGen and called the union "a co-equal partner." Acknowledging the current strife between the FAA and NATCA over a number of contentious issues, including the lack of a negotiated contract, staffing and a new dress code in ATC facilities, Leader said the JPDO stays completely apart from labor issues.

NATCA, however, maintains that the FAA excluded controllers from the NextGen development process in 2002 and has not relented, even though NATCA very much wants to be involved ("AirMail," p. 6).

Leader also said that NextGen will include a new safety management system that will analyze enormous amounts of data to detect evolving patterns of incidents and threats, becoming predictive rather than "forensic" and relying on accident investigations.

Leader said the goal is to develop common reporting requirements — the same data points — for aviation in the United States as elsewhere, with the eventual development of a single global database.

The technology the FAA calls the "backbone" of NextGen and "the future of air traffic control" is automatic dependent surveillance-broadcast (ADS-B), in which each aircraft every second broadcasts its identification, position derived from global positioning system (GPS) data, speed and altitude. Ground stations and aircraft with the proper equipment will receive these data bursts. Ground stations will search for conflicts, and a cockpit display in receiving aircraft will show nearby aircraft locations and other information. ADS-B, already in limited use, provides faster updates and is independent of the ground-based radar system.

The FAA at deadline was about to award the first phase of a contract to build ground stations; competing were industry teams led by ITT, Lockheed Martin and Raytheon. Vincent Capezzuto, FAA director of surveillance and broadcast services, said that the FAA will place primary emphasis on the contractors' costs and how quickly they can get their systems in operation and then expand nationwide.

"We're buying services, not black boxes," he emphasized, explaining that the agency is specifying what the system should do and not the specific equipment to be used. The FAA will be following the same approach in late September, when it issues a notice of proposed rulemaking (NPRM) for the equipment in the aircraft, following a dual-track strategy (Figure 2) in developing the ground structure and the aircraft equipment at roughly the same time. If successful, deployment of the ground infrastructure and aircraft equipment requirements will begin in 2010, Capezzuto said.

The upcoming NPRM will cover only ADS-B "Out," an equipped aircraft broadcasting its position. ADS-B "In" refers to receiving ADS-B transmissions from other aircraft and from ground stations. Mandating ADS-B Out in much of U.S. airspace is essential to achieve the maximum benefits from the system, Capezzuto said.

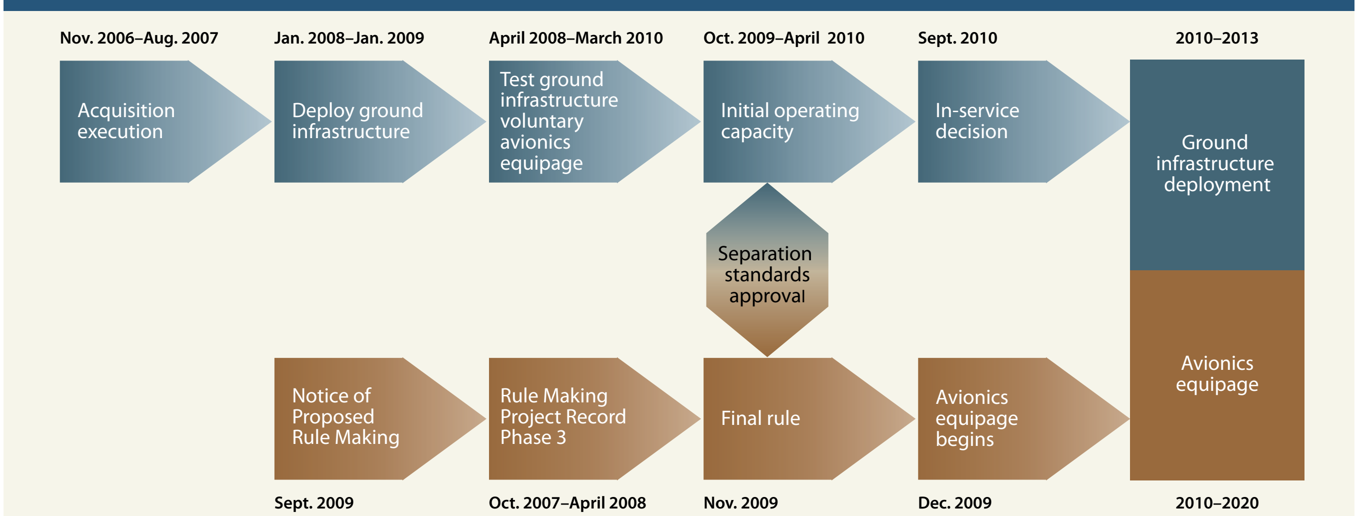
The NPRM will require ADS-B Out capability for all domestic and non-U.S. aircraft that fly in Class A airspace at 18,000 ft and above, in the Class B airspace around the 30 largest metropolitan areas and in Class C airspace around smaller controlled airports with radar service and a relatively high number of instrument approaches. An altitude-encoding transponder already is required to fly in these areas. Capezzuto said that the FAA expects that airlines, business aircraft owners and other operators will equip their aircraft with ADS-B In at the same time they get ADS-B Out to maximize their benefits.

A provision in the NPRM will require that ADS-B's cockpit display abilities meet the current horizontal separation standards for radar — 5 nm (9 km) in the en route environment and 3 nm (6 km) in terminal areas — for eventual self-separation. Capezzuto said that the FAA believes further development and experience with ADS-B will lead eventually to reduced horizontal separation standards, which in turn will increase capacity.

After analyzing comments on the NPRM, the FAA plans to issue a final rule in November 2009, with equipage of aircraft expected to begin soon thereafter.

Meanwhile, the FAA is expanding real-world testing of ADS-B. Following the successful Capstone Project in Alaska, where use of ADS-B in a nonradar environment led to a 40 percent decrease in general aviation accidents, testing of ADS-B is continuing around Juneau, where mountainous terrain severely limits radar coverage. Elsewhere, UPS has outfitted nearly 300 of its freighters with ADS-B to improve operations at its hub in Louisville, Kentucky, where it has achieved significant reductions in fuel consumption, noise and emissions. The airline plans to expand testing to its hub at Philadelphia, which is busier, more congested and

NextGen Dual Track Strategy



Source: U.S. Federal Aviation Administration

Figure 2

uses a different terminal radar system, and is considering expanding the program to its hub at Hanover, Germany.

Extensive ADS-B testing in the Gulf of Mexico is slated to begin in late 2009. In partnership with helicopter operators there, ground stations will be installed on oil drilling platforms in the Gulf to provide coverage at low altitudes. Additional stations on new stand-alone platforms will provide precise high-altitude coverage for airlines flying between the eastern United States and parts of Mexico.

The FAA expects that by 2020, ADS-B will allow it to shut down all but about 40 terminal radars and 150 en route radars, about half the current total, which will remain to provide backup coverage in case of a GPS failure. Those closures are expected to bring significant savings in operational and maintenance costs. FAA does expect to start shutting down some VHF omnidirectional radios (VORs) and nondirectional beacons (NDBs), but as a result of wide area augmentation system, a GPS complement, not ADS-B.

Capezzuto said that the FAA is working closely with Eurocontrol, Air Services Australia and Nav Canada in coordinating ADS-B development in their areas. Eurocontrol also is using performance-based standards to ensure that the systems will be compatible, he said.

The European equivalent of NextGen is the SES Air Traffic Management Research (SESAR) program, with the goal of attaining the following objectives by 2020:

- Triple system capacity;
- Reduce costs by 50 percent;
- Reduce the environmental impact of each flight by 10 percent; and,
- Improve safety — double the traffic with no increase in accidents.

Eurocontrol has divided SESAR into three phases. The first, the definition phase, is on schedule to produce the air traffic management (ATM) master plan by March of next year. The work is being done by the SESAR Consortium, a group of 30 partners, with more than 20 subcontractors and associates, including airlines and other users, the ANSPs, airports, manufacturers and other suppliers, and the military.

The development phase, from 2008 to 2013, will involve the development and validation work and preparation of the necessary regulatory measures. Details of the deployment phase from 2014 to 2020 are still being developed.

Eurocontrol's Redeborn says SESAR is very similar to NextGen, with some differences in systems architecture. As a result, the United States and European ATM systems "will be very similar in 15 years," he said. ADS-B will be a major component of SESAR. Redeborn also expects ADS-B eventually to replace ground-based radars other than those retained to back up the satellite system. He also expects that VORs and NDBs will be phased out in Europe after 2020.

The SESAR safety goal presents special challenges in Europe because of the number of countries and the numerous legal, regulatory and cultural differences among them and their ANSPs.

In its July report, the HLG cited the need to deliver continuously improving safety, the importance of facilitating the uniform application of a "just culture" and the requirement for the EU to "harmonize safety oversight."

In December 2006, Eurocontrol's Performance Review Commission (PRC) released a detailed study, *Legal and Cultural Issues in Relation to ATM Safety Occurrence Reporting in Europe*. It emphasized the need for full, open, transparent reporting of safety incidents in an atmosphere of just culture.

Radu Cioponea, a PRC staff member, safety specialist and former air traffic controller, said that there are no hard data on just how safe ATC in Europe is due to widely varying reporting of safety data among Eurocontrol members. Some countries, he said, are very transparent and open. The PRC report said that some ANSPs fear that openness would damage their relations with the public, insurance companies and investors, and view a safety incident as a failure and a crisis.

The PRC report says that safety communication between ANSP managers and controllers "is far from perfect in a majority" of countries. It cited the need for more training and encouragement of open reporting and said that these efforts should be ongoing. Retraining a controller following an incident is good, but it must not be seen as punitive. The report said that a controller should be relieved of duty with pay after a stressful incident, as in Denmark, whereas in Croatia and Romania, an incident leads to a reduction in pay.

The challenge for Eurocontrol, according to Cioponea, is to resolve the differences between the aviation regulators and ANSPs in countries where they are a barrier to a just culture and the differences between the regulators and their national legal systems[1]. "We need targeted action … to approach the right people who can actually make changes," he said. ●

Shumann had a 35-year career in aviation journalism and public relations. After stints at Aviation Week, the Air Line Pilots Association, GE and Lockheed Martin, he joined the FAA in 1997, where he was the principal spokesperson for the air traffic control system. He retired in 2005.

Note

1. The safety cultures in the FAA Air Traffic Organization and in the United Kingdom were described in the July 2007 issue of *AeroSafety World*.

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BY FSF INTERNATIONAL ADVISORY COMMITTEE

Pursuing Precision

Introduction to a series focusing on the development and safety benefits of precision-like approaches.

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A lack of modern infrastructure and precision approach guidance in many areas of the world often are blamed for approach and landing accidents, yet most aircraft and flight crews in these areas are capable of conducting "precision-like" approaches.

The following article is the first in a series of four written to improve knowledge and awareness of precision-like approaches. These nonprecision approach procedures with constant-angle descent guidance are less complex than traditional nonprecision approaches and are more likely to produce a stabilized final approach, improving operational safety and efficiency.

These articles on the development and benefits of precision-like approaches are the products of the Precision-Like Approach Project, launched by the Flight Safety Foundation International Advisory Committee (IAC) three years ago.

The Foundation documented the risks of nonprecision approaches in the *Approach and Landing Accident Reduction (ALAR) Tool Kit* and other publications.[1] The FSF ALAR Task Force found, for example, that more than half of the accidents and serious incidents involving controlled flight into terrain (CFIT) occur during step-down nonprecision approaches. Other data showed that nonprecision approaches are five times more hazardous than precision approaches. These findings led to a call for expediting the worldwide implementation of precision-like approaches and for training pilots to use these procedures.

While some areas of the world have adopted new technologies to manage the threat of CFIT during approach and landing, other areas essentially are "frozen in time," using navigational techniques developed in the 1940s and 1950s. The IAC has found a lack of knowledge about precision-like approaches — how to fly them and how to design and approve them — despite the fact that most aircraft and flight crews are capable of using them.

In this first article, Capt. Tom Imrich, senior engineering test pilot for Boeing Commercial Airplanes, details the many terms used to describe instrument approach procedures, reviews the evolution of vertical guidance and describes likely future developments.

Capt. Etienne Tarnowski, an experimental test pilot for Airbus, in the second story will discuss methods and procedures currently in place to fly safe non-ILS (instrument landing system) approaches. He looks at the entire spectrum of navaid-based instrument approaches and discusses how the evolution of procedures has been dictated by the way approaches have been defined, the navigation sensors available and the instruments provided to fly and monitor the approaches.

Co-authors Don Bateman, corporate fellow at Honeywell, and Capt. Dick McKinney, who flew for American Airlines, in the third article will discuss the risks of the "dive-and-drive" way of conducting step-down nonprecision approaches and the tools available to reduce the risks.

Capt. Dave Carbaugh, chief pilot for flight operations safety at Boeing, will conclude the series with a discussion of the benefits of precision-like approach procedures, including reduced risk of CFIT and approach-and-landing accidents, lower approach minimums, less noise, decreased fuel burn and exhaust emissions, reduced training costs, increased payload and range, and fewer regulation and infrastructure requirements.

The IAC believes that precision-like approach procedures are a safety improvement that we all should advocate and employ. ●

Note

1. Information about the *FSF ALAR Tool Kit* is available on the Foundation's Web site at <flightsafety.org/ecommerce/default.cfm?Action=Detail&ItemID=897>.

Further Reading From FSF Publications

FSF Approach and Landing Accident Reduction (ALAR) Task Force. "ALAR Briefing Notes." *Flight Safety Digest* Volume 19 (August–November 2000).

FSF ALAR Task Force. "Killers in Aviation: FSF Task Force Presents Facts About Approach-and-landing and Controlled-flight-into-terrain Accidents." *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999).

All-Weather Ops

Approach guidance has evolved from four-course ranges to satellites.

BY TOM IMRICH

"All-weather operations" is a term typically used to describe the use of nonprecision and precision instrument procedures to conduct low-visibility takeoff and landing operations. This article briefly outlines the history of all-weather operations — focusing on the progression from road maps, pilotage and dead reckoning to the first generations of approach guidance to modern satellite-based instrument approach procedures — and takes a look at where we likely are heading for future all-weather operations.

The ability to conduct all-weather operations is critical to both the safety and regularity of global air carrier operations. Without this capability, air carrier operations would not be practical, economical or even possible. But all of the tools available are not being used to their full potential. Safety in all-weather operations today can be significantly improved by applying methods and techniques based on instrument procedures with vertical as well as lateral precision guidance. These include required navigation performance (RNP) procedures and continuous-descent approach operating procedures for aircraft not equipped with flight management systems (FMSs).

The Early Years

The need for all-weather operations, to expand operational capabilities and improve safety, was recognized in the earliest days of aviation. In the 1930s, the ability to conduct all-weather operations was deemed vital to ensure essential activities such as mail delivery and military operations in bad weather and at night.

The need to fly at any time drove the requirements for marking and lighting airways, designating landmarks and lighting and marking airports. It also led to the replacement of road maps with aviation-specific charting, beginning with the detailed notes taken by Elrey Jeppesen during mail runs, and the establishment of rules of the air, including instrument flight rules (IFR) and visual flight rules (VFR), and air traffic separation services, primarily for flying in bad weather.

The evolutionary steps included improvements of aircraft equipment — gyroscopic flight instruments and radios, for example — and external aids, including light beacons at first and later radio beacons such as the four-course visual-aural radio range (VAR), nondirectional beacon (NDB), marker beacons and eventually the VHF omnidirectional radio (VOR).

Simply finding the destination airport in bad weather was hard enough in the early years of aviation. Aligning with the runway and descending precisely during the final stages of a flight typically were tasks accomplished after visual contact was made with the field. The early goals of instrument approach procedures were to define a safe lateral path and specify safe minimum altitudes for the approach and, if unsuccessful, the missed approach. This led to the largely two-dimensional nature of nonprecision instrument approach procedures based on the four-course range, NDB, VOR and later the localizer.

Vertical Guidance Evolves

By the end of World War II, instrument flying had evolved to the point of enabling aircraft to fly in most instrument meteorological conditions (IMC), albeit with significant safety risk remaining in some situations. A comprehensive system of radio navigation aids (navaids), including radio ranges and NDBs, was deployed; charts depicting airways and instrument approach procedures were published; and the early foundations were laid for an airway system largely based on VORs. Early instrument landing systems (ILSs), which provide precise alignment with the runway centerline as well as high-quality vertical guidance to a relatively low height, began to appear.

ILS and ground-controlled approaches (GCAs) were the first real attempts to define a precise lateral path to a runway centerline and a corresponding precise vertical path to fly until the pilot could see the runway to visually complete the approach. These approaches that added the vertical guidance component later became known as precision approaches, or three-dimensional approaches.

Meanwhile, NDB, VOR and tactical air navigation (TACAN) systems and procedures continued to evolve.[1] Their use expanded globally, in parallel with evolving ILS approaches and ground-controlled approaches using precision approach radar (PAR), systems that were significantly more expensive to install at airports. Some approaches also required additional expensive airborne equipment. Hence, ILS and PAR installations were limited to large, busy airports with a high demand for all-weather-operations capability. ILS was predominant for air carriers that could afford to install the required aircraft equipment.

As en route surveillance radars became increasingly used for air traffic separation, airport surveillance radar (ASR) approach procedures also proliferated, but they remained largely two-dimensional.

The localizer centerline guidance component of the ILS could be used by aircraft — typically, general aviation aircraft — that did not have glideslope receivers, leading to the establishment of localizer and back course localizer approach procedures to provide at least a partial benefit from ILS systems, albeit only two-dimensional guidance.

Instrument approach design criteria were incorporated in the *United States Standard for Terminal Instrument Procedures* (TERPS) and later in the International Civil Aviation Organization (ICAO) *Procedures for Air Navigation Services–Aircraft Operations* (PANS-OPS).

The minimum height to which an aircraft could descend on a nonprecision approach originally was called the minimum descent altitude (MDA); for a precision approach, the label decision altitude (DA) was applied.[2] Weather minimums for landing and takeoff were specified with both a visibility component and a ceiling, or cloud base, component.

Systems Mature

ILS eventually prevailed over PAR and ground-controlled approaches, initially for civil operations, because ILS technology provided more operational flexibility at lower cost and supported lower landing minimums.

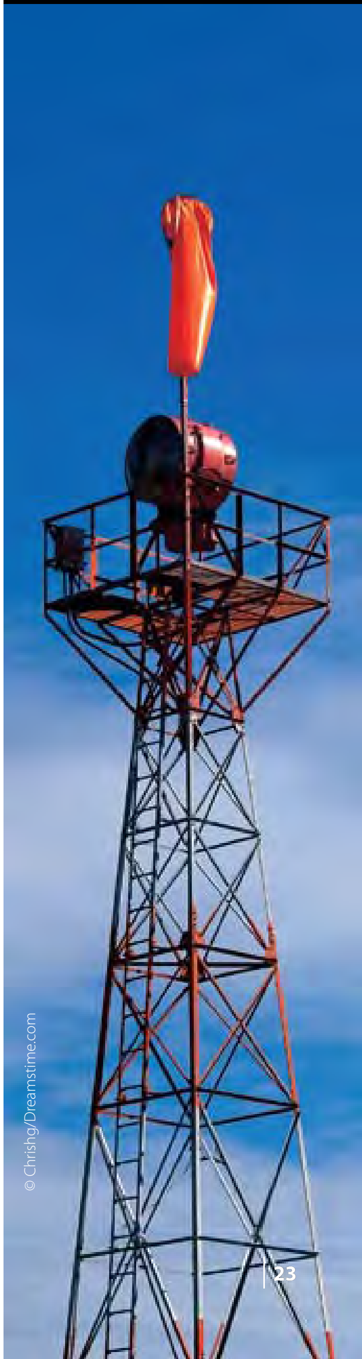
When the airline industry transitioned from propeller aircraft — such as the Douglas DC-4, DC-6 and DC-7, and the Lockheed Constellation — to the early jets — including the Boeing 707, Convair 880 and DC-8 — turbojet aircraft landing minimums were set higher because of the typically higher approach speed, different landing attitude, limited visibility from the cockpit, slower engine response, and perceived different handling characteristics. The resulting "basic turbojet minimums" included a 300-ft ceiling and 3/4-mi (1,200-m) visibility.

Seeking to restore turbojet aircraft landing minimums to the equivalent values used for the earlier propeller-driven aircraft — a 200-ft ceiling and 1/2-mi visibility — the industry, regulatory authorities and ICAO in the early 1960s identified new technology that would permit this operational capability. Autopilot, flight director and flight instrument technologies were applied in stages as the earlier landing minimums were restored.

Civil ILS operations further evolved with technology such as fail-operational autoland systems with rollout capability, to permit Category III operations with runway visual ranges (RVRs) as low as 300 ft (75 m). Head-up display (HUD) guidance systems and fail-passive autoland systems eventually allowed more limited Category III capability for aircraft in which the installation of a fail-operational autoland system was not economically viable.[3]

Despite these advances, the use of NDB, VOR and localizer approaches increased globally during the 1960s through 1980s, primarily for economic reasons, including the lower cost of ground and aircraft equipment compared

Light beacons replaced bonfires as an early method of guiding aviators to landing sites at night or in low visibility.



with ILS. Unfortunately, the safety record of flying nonprecision approaches did not match the improved safety record of precision approaches flown with ILS.

In the 1970s and 1980s, aircraft navigation systems significantly evolved to include multi-sensor flight management systems, electronic displays and area navigation (RNAV) equipment. RNAV capability, which constructs navigation routes using selected points in space, initially at a designated bearing and distance from a VOR, included either two-dimensional lateral navigation (LNAV) alone or three-dimensional navigation employing both LNAV and vertical navigation (VNAV). Many general aviation aircraft systems used only two-dimensional RNAV. Air carrier flight management systems were designed from the start to use three-dimensional path indications based on barometric VNAV (BARO VNAV) information.

Accordingly, air carriers with aircraft having FMSs incorporating navigational databases — for example, the Airbus A320 and the Boeing 757, 767 and 737-300 — began to fly NDB, VOR and localizer approaches using the FMS LNAV/VNAV capability.

Although RNAV instrument approach procedures were implemented widely during this period, the procedures typically were defined and classified as two-dimensional. Landing minimums for all approach procedures were based principally on minimum visibility values, including RVR, and were no longer tied to a required ceiling minimum.

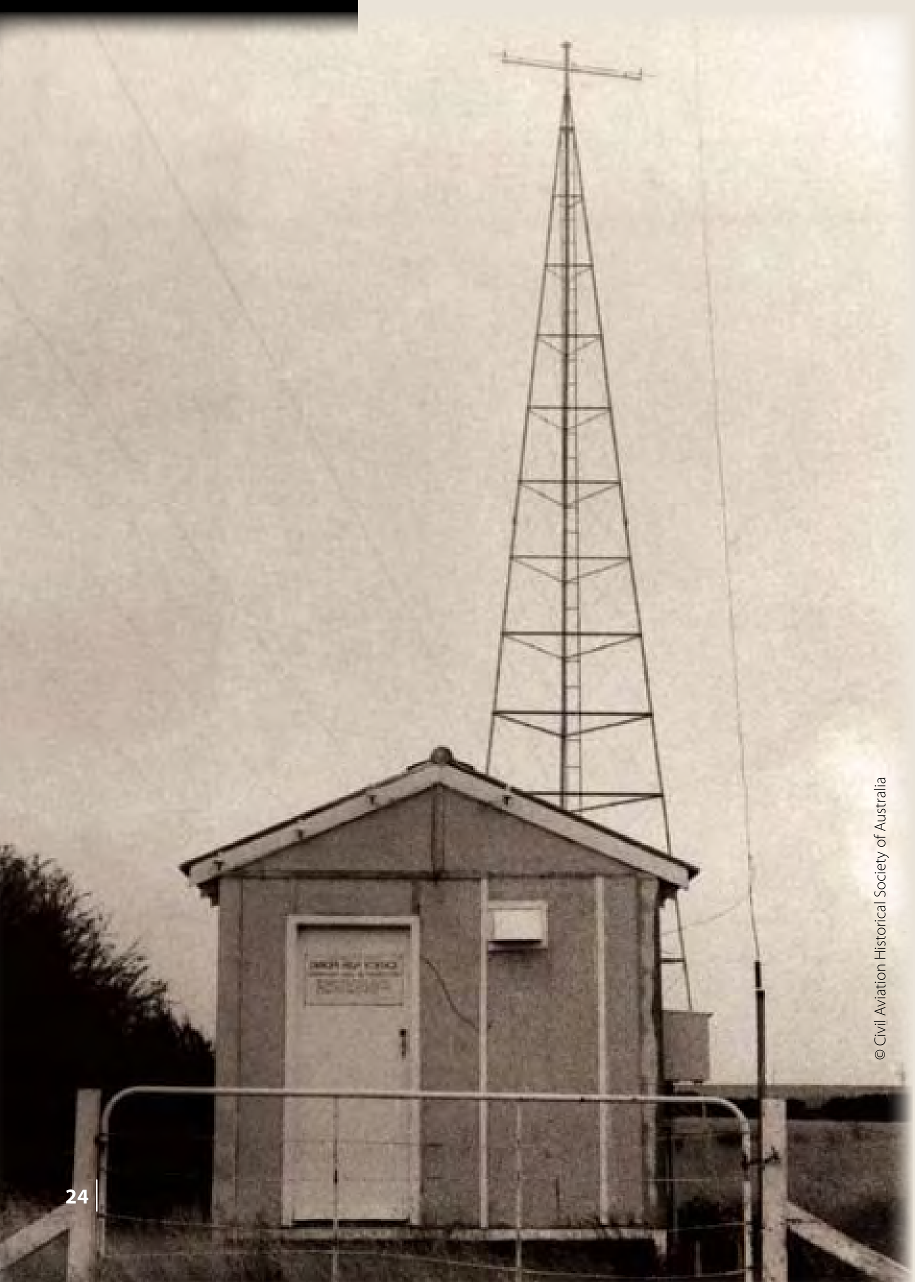
Published MDAs and DAs increasingly included specifications of height above the highest elevation in the runway touchdown zone, as well as minimum mean sea level altitudes. The resulting MDA(H) and DA(H) values were better suited to the use of radio altimeters, which by the 1970s had become common in air carrier operations.

By the end of the 1980s, it became apparent that the stability and accuracy of a well-defined three-dimensional FMS-based path continuing to the runway had both safety and operational benefits, including simpler crew procedures and reduced noise emissions.

Technology Surges

The increased installation of ILS facilities at airports and the widespread availability of fail-operational autopilots in air carrier aircraft during the 1990s enabled the broad use of low Category III landing minimums with specified alert heights.[4]

FMSs enabled the use of RNAV-direct routings and LNAV/VNAV navigation on published standard instrument departures (SIDs) and standard terminal arrival routes (STARs). Where ILS approaches were not available, RNAV techniques could be applied to most other instrument approach procedures. RNAV approach


© Civil Aviation Historical Society of Australia

The transmitter shack and antenna of an early nondirectional beacon (NDB). A radio compass or automatic direction finder aboard the airplane enabled the crew to "home" on the beacon.

© Ralph Duenas/Airliners.net

The Ford Tri-Motor flew in an era of transition from dead reckoning and pilotage to the dawn of all-weather operations.

procedures became ubiquitous. Air carriers applied three-dimensional RNAV using BARO VNAV on a large scale.

For FMS-equipped aircraft, which became the air carrier norm, nearly all nonprecision instrument approach procedures could be flown using the LNAV and VNAV modes. Global positioning system (GPS) inputs became commonly available for multi-sensor FMSs in air carrier aircraft. GPS inputs, together with inertial reference systems (IRSs) and BARO VNAV, significantly increased the accuracy and reliability of guidance available to fly any three-dimensional instrument approach trajectory.

Even though FMS-equipped aircraft have been taking advantage of VNAV capabilities, many nonprecision instrument approach procedures still do not have vertically defined final approach paths. However, because of the widely recognized safety advantage of flying vertically stabilized VNAV paths to the runway, operators have been using FMS BARO VNAV capabilities while conducting NDB, VOR and localizer approaches. As a result of these initiatives, even more operators now are using VNAV for any suitable nonprecision approach procedure, even if a vertical path is not published as part of the procedure.

Similarly, for aircraft that do not have an FMS or VNAV capability, the constant-descent approach (CDA) technique was developed to obtain at least some of the benefit of a stabilized approach and to avoid procedures that have been most vulnerable to human failures, particularly step-down — "dive-and-drive" — nonprecision approach procedures. The CDA technique is based on the use of distance-altitude checks or a pre-planned vertical speed to mimic a VNAV path.

Air carriers have achieved ILS-like performance from their FMSs and, in some instances, even better approach guidance. Multi-sensor FMSs, GPS sensors, IRSs and BARO VNAV systems have matured to provide significantly improved accuracy, integrity and availability, with flexible, defined three-dimensional or even four-dimensional flight path performance. Time, the fourth dimension, is the required time of arrival.

Required navigation performance (RNP) is a refinement of RNAV, applied in a much more systematic and uniform way. RNP, which is used in a number of different levels of performance required of an aircraft's capabilities, more accurately and reliably defines the intended lateral or vertical path. Other types of approach procedures rely on angular navigation information emanating from a specific point that, like the spokes of a wheel, spread out as distance from the navaid or waypoint increases, reducing accuracy. RNP, on the other hand, can have linear navigation design criteria, a thin line in space that can be bent in three dimensions as needed. A typical RNP approach performance value is 0.3 nm, meaning that the aircraft is capable of being flown within 0.3 nm of the course or path centerline, regardless of its distance from the waypoint. To ensure optimum access to airports, or for departure, some RNP procedures now have an RNP performance value of 0.1 nm.

RNP has shown major operational and safety benefits and has become the foundation for the future of global navigation, according to ICAO's Future Air Navigation System (FANS) plan and the U.S. Federal Aviation Administration's Performance-Based Navigation Roadmap.

New Constellations

With the advent of GPS, many general aviation aircraft in the 1990s became capable of conducting two-dimensional RNAV approaches. GPS "overlays" of traditional VOR and NDB approaches were introduced first. Then stand-alone GPS approaches were authorized. GPS approaches were still largely defined as two-dimensional procedures, since general aviation aircraft with panel-mount GPS receivers typically did not have BARO VNAV capability. Eventually, the GPS approaches were reclassified as RNAV approaches.

GPS use initially was subject to "selective availability," in which signal accuracy was intentionally degraded by the U.S. military for security reasons. The U.S. Department of Defense, which owns, operates and monitors the GPS satellite constellation, canceled selective availability in 2000, making signals received by civil aircraft worldwide as much as 10 times more accurate.

Several augmentation systems — collectively called the satellite-based augmentation system (SBAS) by ICAO — have been implemented to further improve GPS accuracy, integrity and availability. These systems include the U.S.-developed local area augmentation system (LAAS) and wide area augmentation system (WAAS), the European geostationary navigation overlay system (EGNOS), India's GPS-aided geo-augmented navigation (GAGAN) system and Japan's multifunction transport satellite augmentation (MTSA) system.

Similar to ICAO's definition of a ground-based augmentation system (GBAS), LAAS originally was proposed with air carrier aircraft in mind, to provide reliable and accurate precision approach guidance ranging from more economical Category I operations to the most demanding Category III landings, as well as low-visibility takeoffs and some airport-surface operations.

Introduced primarily for general aviation aircraft, WAAS eventually led to the development of the localizer performance with vertical guidance (LPV) approach, a GPS approach procedure that provides localizer-equivalent lateral guidance accuracy, an electronic glide path and minimums as low as 200 ft and 1/2 mi for suitably equipped aircraft.

Conference discussions about these technologies led the ICAO Obstacle Clearance Panel to propose a new classification of RNAV procedures called approach procedures with vertical

Instrument landing systems and ground-controlled radar approaches guided the crews of prop-driven airliners, like this Lockheed Constellation, to landings in most instrument weather conditions during the 1950s.

The development of VHF omnidirectional radios (VORs), which emit radio signals 360 degrees in azimuth, provided more precise en route and instrument approach capability.

guidance (APVs). This classification would include subgroups, such as APV I and APV II, to designate various levels of performance accuracy or integrity.

Europe now has committed itself to the deployment of a global navigation satellite system (GNSS) called Galileo, which will be similar to GPS but will include 30 satellites, compared with the current 24 GPS satellites. U.S. policy, however, is evolving toward providing a greater number of operational satellites; the GPS constellation could someday include 32 satellites. A new generation of dual-mode receivers must evolve to simultaneously take advantage of both systems.

In addition to canceling selective availability, the United States has promised long-term global civil GPS use without fees. Hence, with the significantly improved accuracy, availability and integrity currently afforded by GPS, and the greater number of GPS satellites likely to be available, the future role of the satellite-based augmentation systems is somewhat unclear. Eventually, there may be more than 50 active GNSS satellites, likely making SBAS largely redundant and dispensable.

Ground-based augmentation likely will be needed indefinitely to support GNSS-based landing system (GLS) approaches and RNP approaches, and to provide comprehensive navigation services, including air carrier Category III landing and low-visibility takeoff operations. GLS approaches likely will replace ILS approaches, because GLS, using GBAS, can provide significantly better capability and reliability than ILS at significantly lower life-cycle and user costs.

The Future Is Now

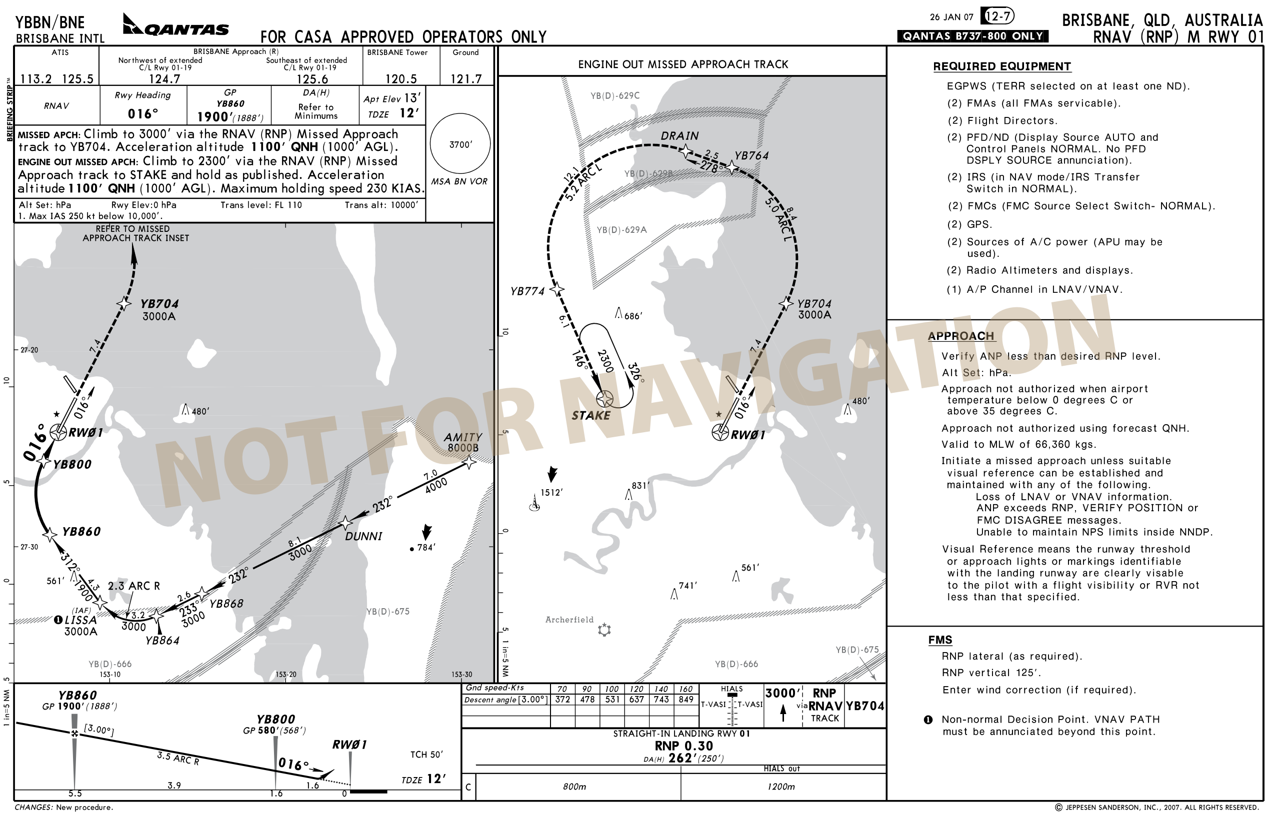
RNP and GLS are a reality. RNP has been in operation for over a decade in air carrier service, both for en route operations and for instrument approach and departure operations. RNP has demonstrated significant safety, economic and operational benefits.

All Airbus and Boeing aircraft currently in production are RNP-capable, and increasing numbers of other aircraft types are being RNP-equipped. RNP is an ICAO standard, an element of the FAA's Performance-Based Navigation Roadmap and is being implemented in many other states — including Australia, Canada, China and New Zealand — as well as states in Europe.

An example of an RNAV RNP instrument approach procedure is shown in Figure 1 (p. 28). RNP can serve virtually any runway. With appropriate criteria and with suitably equipped aircraft, RNP can provide low Category I approach minimums and safe three-dimensional paths to the runway touchdown zone and beyond for a missed approach. The use of RNP can unlock previously unusable airspace and increase runway capacity.

Now entering commercial service, GLS approach procedures provide "better-than-ILS" capability and extend flight operations for suitably equipped aircraft to the lowest Category III landing minimums at any airport with a GBAS, as well as nearby airports that are covered by the primary airport's GBAS.

Three-Dimensional RNAV RNP Procedure



Source: Tom Imrich, from Boeing/Jeppesen

Figure 1

A sample of a GLS/RNAV RNP approach procedure is shown in Figure 2. The procedure is typical of what will be used during the transition to stand-alone GLS approach procedures.

Among evolving beneficial trends, the implementation of both RNP and GLS is likely to:

- Significantly improve safety;
- Reduce operator cost;
- Reduce air navigation service provider cost;
- Reduce vulnerability to human error;
- Simplify training and pilot qualification;
- Reduce cost of aviation system infrastructure;
- Improve and increase air carrier transport operating capability; and,
- Increase airspace system capacity and airport capacity.

The details of these will be discussed in later articles. ●

Tom Imrich is a Boeing senior engineering test pilot currently supporting the 747-8 and 787 programs. He holds bachelor's and master's degrees in aeronautics and astronautics from MIT, and served in the U.S. Air Force, where he conducted research on wind shear avoidance and low visibility takeoff and landing. With the FAA from 1976 to 2001, Imrich was involved in the development and implementation of Category III approach and landing procedures, RNP procedures, the traffic-alert and collision avoidance system, FANS, data link, and advanced pilot training criteria.

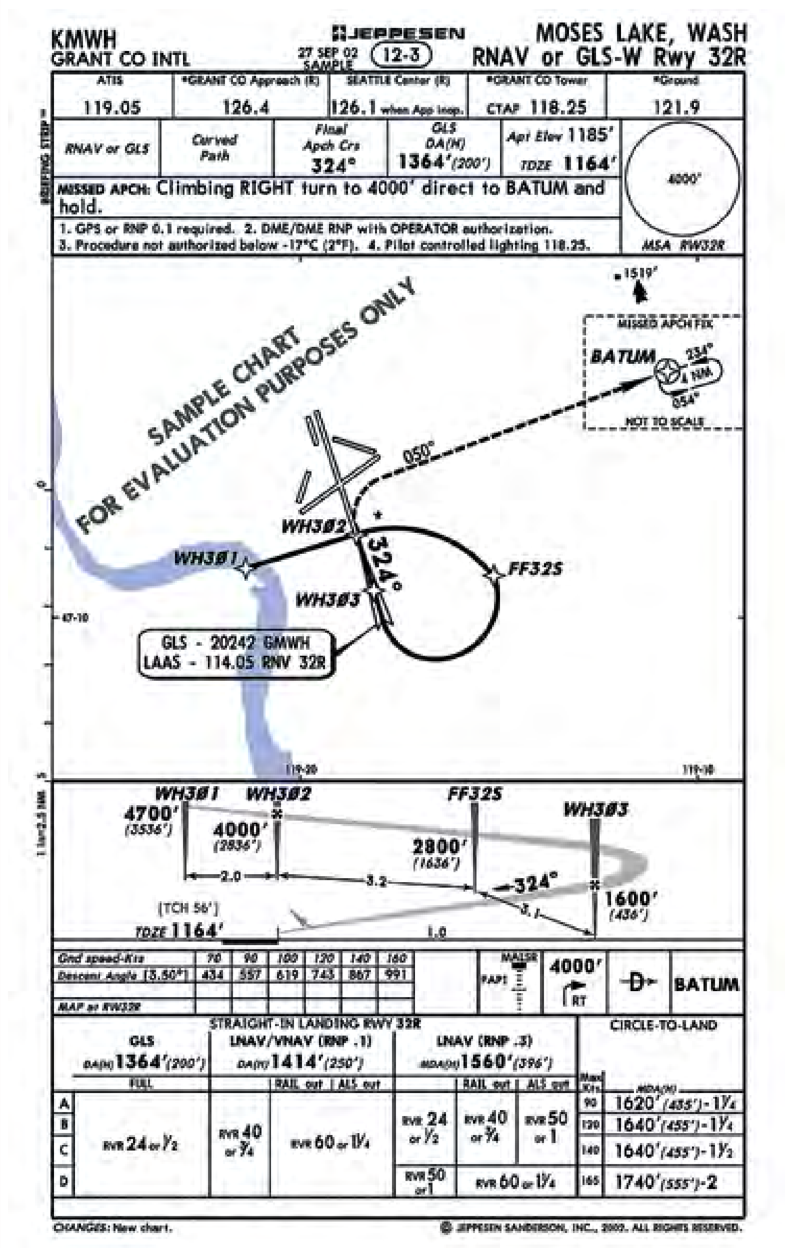
Notes

1. Tactical air navigation (TACAN) is primarily a U.S. military UHF navigation system that provides continuous indications of bearing and distance to TACAN stations. The U.S. Federal Aviation Administration has integrated TACAN facilities

Ground-based ILS equipment may someday go the way of four-course ranges as satellite systems and procedures predominate in providing three-dimensional precision approach capability


© Chris Sorensen Photography

GNSS-Based Landing System Approach



Source: Tom Imrich, from Boeing/Jeppesen

Figure 2

with civil VOR/DME (VHF omnidirectional radio/distance measuring equipment) facilities; the integrated facilities are called VORTACs.

2. In the United States, the term decision height (DH) has been used to specify, as an altitude above mean sea level, the height above the highest elevation in the runway touchdown zone. To harmonize with international terminology, the U.S. has adopted the term decision altitude (DA) and is replacing DHs with DAs on all charts of instrument approach procedures with vertical guidance.

3. A fail-operational autoland system continues to operate safely after the failure of a single component. A fail-passive autoland system is automatically deactivated when a component failure occurs.

4. The alert height is the minimum height above the runway at which a Category III approach must be discontinued and a missed approach begun if a failure occurs in one of the redundant parts of the aircraft's fail-operational autopilot. The approach generally can be continued if the failure occurs below the specified alert height, which is established during aircraft certification and has no relation to decision height.

Eurocontrol Provides Alerts

Program offers information with regional and global benefits.

BY TZVETOMIR BLAJEV

Eurocontrol is offering a new safety alert service. The alerts are designed to increase awareness about hazardous situations before an accident or even an incident might bring it to wider attention. Nothing is more useless to the victims of an accident as hearing, in the aftermath, "We knew about that problem, the solutions have been known for ages. How come they didn't know?"

Eurocontrol's Safety Alert Service Information was implemented to share information about newly perceived or developing threats and how to avoid or manage the threats. Our vision is a vibrant network that delivers urgent safety information to everyone concerned, originating from any system participant, filtered through Eurocontrol's review process.

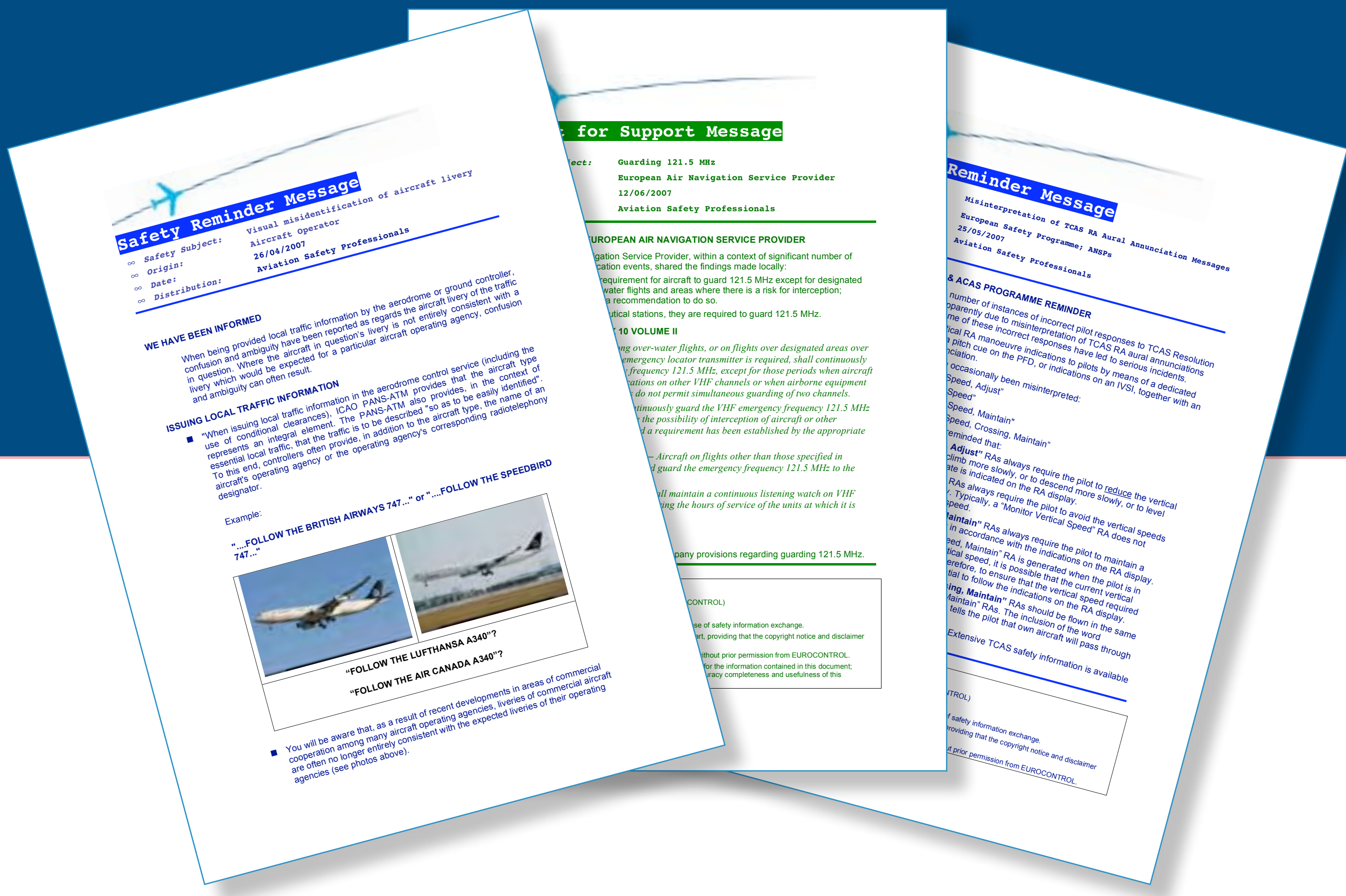
Any aviation professional from any part of the world can trigger the process when in their daily work they come upon a potential safety hazard. Eurocontrol quickly processes these inputs, investigating the relevant standards, validating the issue with experts in different fields and aligning the results with previous experiences. Then it sends the information back to the network as a safety alert.

Here's an example of how this process works: An airline safety officer, reviewing his confidential reporting system, became concerned about the increasing number of visual misidentifications due to the increasing use of nonstandard airliner markings. In this case, it concerned Star Alliance aircraft.

Star Alliance, a network of 17 airlines, operates some aircraft in the alliance's livery with few clear markings to identify the specific airline the aircraft belongs to. Here's what the reporting safety officer wrote:

"One of our flights was about to taxi out and take off from London Heathrow — dense foggy weather at the airport — and the crew was instructed by [air traffic control] to 'follow an Air Portugal A321 coming from the right.' The aircraft was painted in a livery of Star Alliance and, according to the crew statement, it took the pilots some three minutes to identify the aircraft and clarify the situation, heavy [radio communications] and dense fog taken into consideration.

"We would like to raise a possible discussion on whether, especially in foggy [meteorological] conditions and during heavy [radio transmissions], some additional information should be issued or provided by the controller in order to lower the risk of confusion or misunderstanding. To offer a possible solution of the problem,



maybe bringing recommendations on the 'mandatory level' in terms of putting a remark into the [operational flight plan] in order to give notice that the flight is operated by an aircraft that does not wear a standard operator's paint would be helpful."

Eurocontrol examined the issue and relevant reports and alerted service subscribers. In the alert, we reminded air traffic service providers to take particular care when describing aircraft in local traffic information, particularly regarding the use of conditional clearances.

On another occasion, we became aware that there had been instances of incorrect pilot responses to traffic-alert and collision avoidance system (TCAS) resolution advisories (RAs), apparently due to misinterpretation of TCAS RA aural annunciations and RA displays. The alert we issued reminded crews of the correct interpretation of the following RAs: "adjust vertical speed, adjust," "monitor vertical speed," "maintain vertical speed, maintain" and "maintain vertical speed, crossing, maintain."

Sometimes we issue a safety alert containing a request for advice or support, like the alert we issued on June 12 this year concerning procedures for monitoring the 121.5 MHz emergency radio frequency. The alert was based on a request received from a European air traffic service provider, and a large number of responses were received from airlines and air traffic control units showing the differences in local policies and standard operating procedures.

If you would like to join this free network and receive the safety alerts, send an e-mail to <tzvetomir.blajev@Eurocontrol.int>.●

Tzvetomir Blajev is coordinator of safety improvement initiatives at the Safety Enhancement Business Division of Eurocontrol. A former air traffic controller, Blajev was head of the Bulgarian Air Traffic Services Authority Safety and Quality Control Department and is a member of the FSF European Advisory Committee.

EUROCONTROL

Accident Investigations Still Important

BY KYM BILLS

I detect four threats to the role of professional safety investigations required under the Chicago Convention and the standards and recommended practices in International Civil Aviation Organization (ICAO) Annex 13.

The first threat is the notion that reactive investigations have had their day, and what is really important is the proactive analysis of safety data. Second is the need for increased professionalism and timeliness in safety investigations because of the changing media and political environment. Third is the confusion — and sometimes the agenda of labor groups — that "just culture" means no blame or liability even in instances of serious and deliberate wrongdoing. And fourth, at the other extreme, is the growth and resurgence of litigiousness and criminalization.

I will discuss the first and second of these items in terms of the need for an inclusive approach rather than an either/or view, and the third and fourth items in terms of a discussion in which the truth probably resides somewhere toward the middle.

Often, professional investigations do much more than just remind us of past lessons.

Of course, safety regulation based on reactive accident investigations is, by itself, insufficient. We should supplement this by investigation of serious incidents and, preferably, of other incidents of particular safety significance. Within the limits of its budget, the Australian Transport Safety Bureau (ATSB) does this.

Further, the proactive use of the line operations safety audit methodology and flight operational quality assurance data is increasingly important. Good industry safety management systems include confidential reporting and, until they reach widespread maturity, can usefully be supplemented by national confidential reporting systems like the U.K.'s CHIRP (Confidential Human Factors Incident Reporting Programme) or the ATSB's new REPCON. Published research and analysis of de-identified databases and incident trends are also very valuable.

Accident investigation by safety investigators remains essential if only to remind us of the continuing need for vigilance to avoid the human and other factors that have led to so many accidents and fatalities. Often, however, professional investigations do much more than just remind us of past lessons. There are new and unusual twists in safety improvements based on differing organizational cultures and pressures, regulatory environments and interfaces with other humans and changing systems and technologies.

To achieve the necessary investigative rigor and professional consistency, the ATSB has invested heavily in competency-based training and developed a detailed methodology that ultimately requires assessing a probability of more than 66 percent to classify any safety factors as contributory to an accident. Interested readers can see this applied in our recent report on a 15-fatality controlled flight into terrain accident at Lockhart River in Queensland.[1]

I believe this 500-page report on the worst civil aviation accident in Australia since 1968 is a work of high quality. More controversial than the report was the fact that it took almost two years to be released. While there were several interim reports, and the investigation was complicated by an inoperative cockpit voice recorder (CVR), no witnesses and the extent of destruction of the Metroliner 23, two years is a long time. A post-investigation evaluation is seeking ways that this could be improved.

At a recent meeting of the International Transportation Safety Association in Ottawa, Canada, the Russian Interstate Aviation Commission (IAC) outlined its investigation, with the assistance of the French Bureau d'Enquêtes et d'Analyses and the U.S. National Transportation Safety Board, of the Irkutsk Airbus A310 accident, completed in well under a year. I was told that media in Russia and other IAC member states would not tolerate a two-year investigation. I suspect that this may be increasingly true globally. Getting the balance right between professionalism and timeliness and explaining any need to take longer will be an increasing challenge if safety investigations are to remain relevant.

As James Reason has argued, engineering a just culture in which the 10 percent or so of willful and culpable actions leading to accidents and incidents do not escape sanction while encouraging reporting and learning about the other 90 per cent is "the all-important early step." Yet I have heard regulators in another industry suggest that a just culture should involve only "no blame" investigation, while some aviation professionals and unions seek 100 percent protection. On the other hand, we have seen judicial systems imprison crewmembers who have done little more than be involved in an accident because of actions and omissions that resulted from the types of error expected among all humans.

The desired implementation of the Global Aviation Safety Roadmap in terms of protecting safety data to enable its wider and more timely sharing is predicated on robust legislation in member states. This is a great challenge for many poorer states but also for some of the otherwise best-practice members. In the United States, for example, much sensitive investigation data held, including CVR transcripts, must be made available via a public docket, even when it is sourced from another state of occurrence. France has similar challenges because of the nature of its judicial system. The new Attachment E to ICAO Annex 13 seeks to provide guidance with respect to some of these legal difficulties, but serious tensions remain in the annex itself.

The ATSB has not been immune from legal and regulatory pressures in Australia. Legislation enacted in 2003, including the Transport Safety Investigation Act, protects safety information obtained and analyzed by the ATSB as a "no blame" safety investigator. A just culture is preserved through the ATSB taking a cooperative approach to any required parallel investigations by regulators, police or other bodies, but these must be entirely separate and gather their own data and evidence. This is particularly important because the ATSB can compel evidence that may otherwise incriminate. ATSB reports cannot be used in criminal or civil courts, but they can be used in an inquest held by an Australian state or territory coroner. Australian legislation does allow the contents of a CVR to be used in cases of severe criminality unrelated to normal crew duties, such as drug running or terrorism.

Defining exceptions where, for example, serious and imminent risk may require use of otherwise restricted information may be a necessary, if hard, step toward achieving a sustainable balance between no-blame and criminalization and a truly robust just culture. Consistent with Attachment E to Annex 13, I believe that this is required for future accident investigation and for proactive data sharing and analysis, both of which we need to meet the challenge of continuing to reduce aviation accidents globally. ●

Note

1. Report 200501977 accessible at <www.atsb.gov.au>.

Kym Bills has been executive director of the multi-modal Australian Transport Safety Bureau since its foundation in July 1999, and is the immediate past chairman of the International Transportation Safety Association.

Australian Transport Safety Bureau

Failure to Look

The pilot of an EC 130B4 was killed in a collision with another helicopter during a nighttime approach to a busy heliport.

BY LINDA WERFELMAN

Two helicopters on simultaneous nighttime approaches to a heliport at a Florida racetrack collided because neither pilot was maintaining an adequate visual lookout, the U.S. National Transportation Safety Board (NTSB) says.

The Nov. 20, 2005, crash killed the pilot of a HelicopterShuttle.com Eurocopter EC 130B4; the pilot of the other helicopter — a Biscayne Helicopters Eurocopter (formerly Aerospatiale) AS 350B — was uninjured. Both helicopters were substantially damaged.

In its final report on the accident, the NTSB cited as a contributing factor the failure of the AS 350B pilot to comply with approach procedures suggested in the operations manual for Motorsports Complex VIP Heliport, also known as Speedway Heliport, in Homestead, Florida. Findings of the investigation were that the pilot of the EC 130B4 intentionally operated the helicopter "with known deficiencies in equipment (inoperative landing light)" and that Speedway Heliport personnel failed "to conduct a safety briefing in advance of the race, flight-test temporary lighting to see whether any issues [existed] and require a single-point entry and reporting point for approach to the heliport."

The crash occurred about 2048 local time in night visual meteorological conditions. Both helicopters were arriving to pick up passengers who had attended a Ford 400 NASCAR Nextel Cup Series automobile race that had just ended at the Homestead-Miami Speedway.

The flight of the AS 350B originated about 2043 from Ocean Reef Club Airport in Key Largo; the EC 130B4 departed at 2038 from Kendall-Tamiami Executive Airport in Miami (Figure 1, p. 35).

Transcripts of Homestead Air Reserve Base air traffic control (ATC) radio communications showed that the pilots of both helicopters established contact and acknowledged traffic advisories before contacting "race control."

The AS 350B pilot said that after he contacted the individual providing traffic information at the racetrack, he was told to report when his flight was 1.0 nm (1.9 km) south of the heliport. When he did, he was told to follow an Agusta 109 "to the pad," the report said.

© Mike Nowak/Airliners.net

The pilot said that after he turned the AS 350B from a modified right base onto final, he "felt a shudder, and then the aircraft started to vibrate significantly."

He said that he heard the president of Biscayne Helicopters say, on the radio frequency, that there had been a midair collision, and then he conducted a run-on landing on grass west of the helipads.

"While the helicopter started to slow, it began turning and listing to the left," the report said. "He braced when he saw the main rotor blades contacting the ground, and when they slowed, he executed the emergency shutdown procedures. He then exited the helicopter from the right main cabin door."

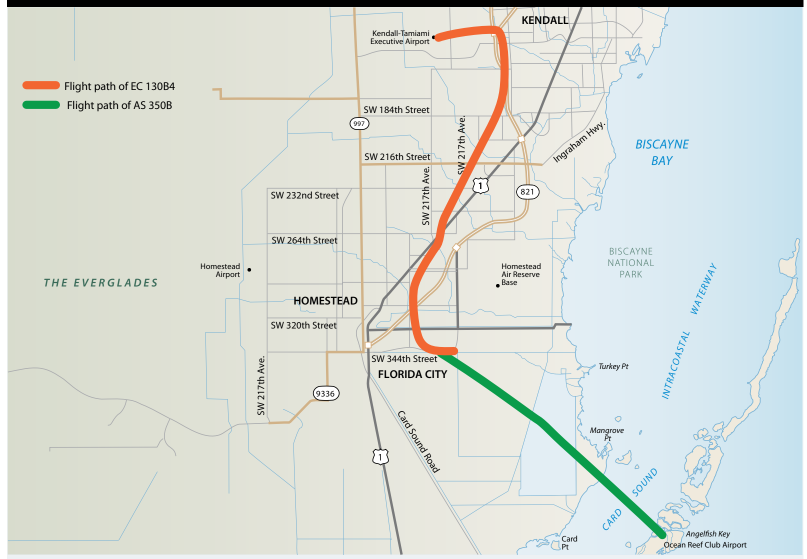
The pilot told investigators that he did not remember hearing a radio transmission from the pilot of the other helicopter or seeing another helicopter in the landing pattern, except for the Agusta that he had followed.

He said that the surrounding area was well-lighted and that he saw the blinking lights of numerous police cars on a road south of the heliport. At the time of the accident, the strobe lights, position lights, instrument lights and searchlights on the AS 350B were illuminated, he said.

Another pilot who conducted a departure about the same time said that there were so many lights at the heliport and in the surrounding area that "it was almost like daylight there down on the ground." In addition, the report said that "pyrotechnics [a fireworks display] occurred immediately before the collision."

The report said that an individual at Speedway Heliport was using — without permission — a radio frequency assigned to the ATC at North Perry Airport, about 40 mi (64 km) north, to provide visual flight rules (VFR) advisory service to pilots during their approaches and departures from the facility. The pilots of both accident helicopters had announced on that radio frequency that they were inbound for landing. The radio operator said that, as the helicopters approached, he saw the AS 350B, which was advised to land on the west side of the Speedway Heliport area, but not the EC 130B4, which was on a straight-in approach, landing to the east on the west pad.

Helicopter Flight Paths



Source: U.S. National Transportation Safety Board

Figure 1

Witnesses said that the AS 350B was southwest of the heliport when the pilot turned it to the east; at the same time, the EC 130B4 was west of the heliport, also on an easterly heading.

"Witnesses reported the AS 350B helicopter was slightly higher and to the right of the EC 130B4 helicopter, and the AS 350B helicopter appeared to be flying at a faster speed," the report said. "One witness reported that the AS 350B helicopter was 'coming in hard' with respect to speed and vertical descent rate, while another witness reported that the AS 350B helicopter overtook the EC 130B4 helicopter and appeared to be flying at twice the speed of the EC 130B4."

The report said that the EC 130B4's main rotor blades struck the left skid of the AS 350B. The EC 130B4 descended immediately, and the pilot of the AS 350B flew the helicopter east to land on grass at the heliport.

The pilot of the AS 350B held a commercial pilot certificate with helicopter and airplane single-engine land ratings, an airline transport pilot certificate with an airplane multiengine land rating and a first-class medical certificate. He had 7,000 flight hours, including 4,600 flight hours in

The pilot of this AS 350B — photographed at the racetrack heliport before the accident — said he felt significant vibration as he landed the aircraft after the midair collision.

rotorcraft. He had worked for Biscayne Helicopters at several times and in several capacities; the latest was as a contract pilot, beginning Oct. 11, 2005. Company records showed that, from Oct. 11, 2005, until the time of the accident, he had accumulated 43.6 flight hours; the day of the accident, he had 6.4 flight hours, the report said.

The EC 130B4 pilot held a commercial pilot certificate with a helicopter rating, an instrument helicopter rating, and a second-class medical certificate. He had 2,717 flight hours, all in helicopters. He was hired by HeliFlight (doing business as HelicopterShuttle.com) on Jan. 10, 2005, and after several months of training, was assigned as pilot-in-command of EC 130B4s on April 21.

The AS 350B was manufactured in 1981 by Aerospatiale as an AS 350D and was converted to an AS 350B in accordance with a company service bulletin; it was certificated as a normal category helicopter and was equipped with a landing light, position lights and an upper strobe light.

Maintenance records from April 1, 2005, until the accident showed no entries for the helicopter's external lights. Two radio discrepancies were noted during that period, and both were corrected several months before the accident. The last scheduled maintenance before the accident was a 100-hour inspection on Sept. 29 at 6,483 flight hours, 41 flight hours before the accident.

The report said that the "External Preflight Inspection" checklist included specific instructions to check the landing light, taxi lights, instrument lights and anti-collision lights and that "a review of an undated aircraft maintenance log sheet, presumed to be for the accident date, revealed a signature of the accident pilot."

The EC 130B4 was manufactured in 2004 by Eurocopter France; a standard/normal airworthiness certificate was issued the following year by the U.S. Federal Aviation Administration (FAA). The helicopter had a landing light, taxi light, position lights, a red strobe light atop the vertical stabilizer and a strobe light on the bottom of the fuselage.

Records indicated that three times during the spring and early summer of 2005, bulbs were replaced in the tail position light of the EC 130B4. Maintenance personnel traced the frequent burnouts of the bulb to vibration from the helicopter's fenestron; after the vibration was corrected, the burnout problem ended, the report said.

The last inspection of the EC 130B4 occurred during a 100-hour inspection on Sept. 7 at a total time of 181 flight hours. When the accident occurred, the helicopter had been flown 76 flight hours since the inspection.

The EC 130B4 flight manual said that daily operating checks must be conducted on a number of items, including the taxi light, landing light and external lights on the vertical stabilizer and fin. Paperwork found in the wreckage included a "Daily Inspection" item that contained an entry dated Nov. 20 with a signature "consistent with other signatures of the accident pilot," the report said.

According to the operations manual, the facility's radio operator was responsible for directing aircraft movement at the heliport.

Operators of both accident helicopters had submitted applications to operate at the heliport; those applications included signed statements that they had copies of the heliport's operations manual and that they would comply with its procedures. Each application included space to list the names of two helicopter pilots; the name of the EC 130B4 pilot was listed on the HelicopterShuttle.com application, but the Biscayne Helicopters application did not include the name of the pilot of the AS 350B.

Both helicopters were listed as authorized to enter Homestead-Miami Speedway special use airspace.

A September 2000 agreement between the speedway and the Homestead Air Reserve Base ATC tower said, "All aircraft shall be responsible for providing their own separation under VFR ... during entry/exit to [the speedway] complex and while operating in the vicinity."

The agreement also said that, unless instructed otherwise by the control tower, pilots of helicopters arriving from the east and south "will enter the … airspace in the vicinity of Turkey Point at or below 500 ft MSL [mean sea level] and proceed direct to Point 'S,' direct to [the heliport] pad." However, the pilot of the AS 350B, which was approaching the heliport from the southeast, was told by a tower controller to fly direct to the racetrack, the report said.

The director of operations for HeliFlight told investigators that the pilot of the EC 130B4, one of two company pilots handling race-related flights, had not been trained by the company for flights to the heliport. He also said that there had not been a safety briefing that year on racetrack flights.

The other HelicopterShuttle.com racetrack pilot said that the accident pilot had flown to the heliport once before the race and that the track had been closed during that flight. The pilot also said that he had asked the "racetrack representative" — the same person who handled radio communications the night of the accident — about a mandatory pilot briefing.

"He was advised there would be no safety briefing this year, since 'the operation is well-established, with a good safety record,'" the report said. "The racetrack representative briefed him on items including power lines, suggested approach paths, communications and reporting points. On Nov. 17, 2005, he [the other HelicopterShuttle.com racetrack pilot] briefed the accident pilot on what he was briefed on by the racetrack representative and specifically discussed the safety hazards, approach paths, radio communications [and] reporting points. He also suggested that a steep approach be conducted, but no approach speeds were discussed."

Later in the day, the accident pilot confirmed that he had received copies of the operations manual and the agreement between the racetrack and Homestead Air Reserve Base and that he had no questions because the information was "straightforward and clear," the other pilot said.

The president of Biscayne Helicopters told investigators that the company's chief pilot had briefed all company pilots involved in racetrack flights before the Nov. 20 race and had discussed the operations manual and the racetrack–air base agreement.

"Additionally, the pilot of the AS 350B helicopter and another company pilot flew into the [heliport] before the day of the race during the daytime to re-familiarize themselves with the heliport and the surrounding area, installed equipment at the heliport and procedures," the report said.

Both operators said that a safety briefing was not conducted before the start of flights to and from the heliport. The president of one operation said that a night flight along the routes to be used had been planned to "determine if there were any issues with in-place lighting" or other problems, but the flight did not occur because of "a natural disaster."

FAA Advisory Circular (AC) 00-61, dated July 24, 2000, recommends safety briefings for all participants in flight operations associated with auto-racing events to discuss a number of topics, including night operations. The AC does not discuss speed restrictions but depicts "a single altitude to be flown, a frequency changeover point and one route to the event site and heliport," the report said.

Witnesses saw exterior lights on both helicopters before the collision, but several saw that the EC 130B4's landing light was not illuminated; it had previously burned out, the report said.

The chief pilot for Biscayne Helicopters said that during night flights to the heliport, "it is sometimes difficult to locate another aircraft … due to ground lights (motor vehicle traffic). … Ground checkpoints are difficult to identify at night, making sequencing of aircraft uncertain at times, as aircraft are not always calling in (to the helipad) at regular or known checkpoints. This makes visually identifying other aircraft difficult for both pilots and ground personnel. Maintaining a close listening watch to radio traffic is essential."

Someone acquainted with both pilots said that after an earlier flight on the night of the accident, he told the pilot of the EC 130B4 that the landing light was not illuminated. The pilot replied, "Oh, sorry about that. Thanks, man." When the helicopter departed, the landing light still was not illuminated, the report said. ●

This article is based on U.S. National Transportation Safety Board accident brief no. MIA06FA022A and the accompanying public docket.

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PERCHANCE TO *Dream*

Crew rest facilities assume critical importance when flights exceed 16 hours.

BY WAYNE ROSENKRANS

Crew rest facilities conducive to deep sleep, as on the Boeing 777-200LR, require caution about possible effects of sleep inertia, initial disorientation/grogginess after waking.

Despite the difficulty researchers have in scientifically isolating the effects of crew rest facilities on quantity and quality of in-flight sleep from other aspects of alertness management, there is no debate about the importance of the sleeping environment. Crew rest facilities designed around guidelines from the 1990s for *long-range* operations, flights of 12 to 16 hours, have been accepted by the airline industry as a significant factor in counteracting fatigue. Since 2005, some airlines also have found that part of the guidance published for *ultra-long-range* (ULR) operations has the potential to improve pilots' and flight attendants' ability to obtain sleep on long-range flights as well. All ULR operations require optimizing time spent in crew rest facilities, protecting crew sleep from disruption except during emergencies and crew coordination to manage sleep inertia after in-flight rest.

Operating Singapore–New York flight sectors with the Airbus A340-500, Singapore Airlines averaged 18.5 hours flight time and 20.5 hours duty time when it set the precedent for ULR operations. The term means out-and-back flights between an approved city pair using a specific aircraft type with a defined departure window and planned flight-sector lengths, or block times, greater than 16 hours and flight-duty periods from 18 to 22 hours. Other airlines have planned or launched ULR operations under evolving regulatory oversight methods that focus on operations specifications for proposed city pairs rather than applying prescriptive rules to all airlines. For example, Delta Air Lines began using the Boeing 777-200ER and Air India began using the 777-200LR for daily New York–Mumbai operations in November 2006 and August 2007, respectively.

During a ULR flight, one captain — the pilot-in-command of the flight — and one first officer typically comprise the main crew. Another captain and another first officer, comprising the relief crew, alternate with the main crew in flight deck duty and in obtaining sleep during at least two precoordinated in-flight rest periods. Cabin crewmembers take rest similarly. Before and after ULR flights, pilots and flight attendants follow prescribed sleep schedules designed to enable them to be fully rested and alert before the next flight.

In 2005, the ULR Crew Alertness Steering Committee cosponsored by Airbus, Boeing Commercial Airplanes and Flight Safety Foundation — distilling consensus recommendations from specialists who participated in workshops over four years — said that a high priority in airline preparations for ULR flights should be to integrate fatigue risk management systems into safety management systems, with crew rest facilities as one of many elements.[1]

"Preventing degradation of crew alertness and performance during ULR flights involves issues beyond simply managing fatigue as practiced in current long-range operations," Capt. Dennis Dolan said in a letter (*ASW,* 8/06, p. 6) as president of the International Federation of Air Line Pilots' Associations (IFALPA). "IFALPA urges the promotion and adoption of the Flight Safety Foundation ULR Crew Alertness Steering Committee recommendations and guidance material to all regulatory agencies that will be providing the oversight that is necessary to maintain existing standards of safety during these longer range operations. A cautious approach is warranted until such time as a sufficient body of information is available from which to make more specific conclusions."

The steering committee postponed development of detailed recommendations to improve crew rest facilities — relative to existing specifications for long-range operations — pending discussions of proposed standards and recommended practices for fatigue risk management, scheduled for fall 2007 within the International Civil Aviation Organization.

For example, in the United States, the Federal Aviation Administration (FAA) advisory circular for crew rest was published in 1994 as one acceptable means of compliance with regulatory requirements for on-board sleeping quarters and rest facilities "for flight crewmembers to obtain sleep of adequate quality during flights scheduled for more than 12 hours during any 24 consecutive hours."[2] A related document used by many states — the aerospace recommended practice for crew rest facilities published by SAE Aerospace in 1992 — was reaffirmed by specialists with only format/editorial changes in December 2006.[3] The steering committee's *Ultra-long Range Crew Alertness Initiative – Recommended Guidelines* also specify crew rest facilities mostly comparable to those required for long-range operations. "Because on-board crew sleep is a critical factor in ULR operations, the quality of the crew rest facility is of paramount importance," these guidelines say.

In the FAA guidance, the key ideas are to provide enough separate sleeping surfaces for crewmembers taking simultaneous rest periods; adequate volumes of space for ingress/egress, changing clothes and sleeping with adequate privacy; minimum dimensions for each sleeping surface; physically isolating the crew rest facility "in a location where intrusive noise, odors and vibration have minimum effect on sleep"; designing the facility for a background noise level of 70 to 75 dB(A) during cruise flight; and ensuring that only relevant announcements via the public address system reach sleeping crews, such as notification of in-flight smoke/fire/fumes, aircraft depressurization or preparation for landing.

This guidance also says that airflow and temperature controls in the crew rest facility should provide "a uniformly well-ventilated atmosphere free from drafts, cold spots and temperature gradient." Occupant seat belts for each seat and bunk, illuminated signs that convey the on-duty captain's instructions to fasten seat belts, approved emergency oxygen equipment for the emergency descent after cabin depressurization and emergency lighting also are considered important equipment.

The SAE Aerospace recommended practices currently apply to "commercial transport aircraft capable of ultra long range operations with augmented/enlarged crew complement." Elements that go beyond the FAA guidance include optional inclusion of sleeping seats that meet SAE criteria as a flat horizontal sleeping surface; level sleeping surfaces during cruise; private access to a nearby lavatory; a method to bar entry of passengers; individual reading lights; smoke detector; consideration of humidification; an audible signal to summon sleeping crewmembers to the flight deck; nonintrusive intercom; and secure stowage so that crewmembers' carry-on bags, clothing and shoes cannot be dislodged by severe turbulence.

The steering committee's guidelines in part say, "Ideally, each resting pilot should have an individual sleeping compartment with facilities available to enable him or her to have a choice of a comfortable reclining seat or sleeping surface at all times. These facilities should be separated from the flight deck and not be positioned in the passenger cabin."

Research has focused in part on providing sound dampening, 16-g seats, adequate heating and ventilation, humidification systems, reading lights to minimize disturbance to sleeping occupants, vertical space and sleeping surface dimensions, handholds and other fall protection on stairs, and multiple emergency egress paths, according to Boeing.

Protecting In-Flight Sleep

Independent studies of early ULR flight operations found that the typical quantity and quality of sleep obtained by pilots, their alertness levels and their reaction-time performance were not less than those previously measured during long-range flights, the steering committee said.

In applying this guidance, and the initial requirements for ULR operations from its national civil aviation authority, Singapore Airlines has provided pilots a lie-flat bunk, a reclining seat when the bunk is stowed, temperature control, humidification and an in-flight entertainment system. Scientists found that the airline's pilots obtained, on average, total sleep lasting from about two hours 15 minutes to four hours within the maximum five-hour rest period. In diaries kept by crewmembers, turbulence was the most commonly cited factor disturbing sleep, mentioned in one-third of all entries.

In early ULR operations, crews spotlighted heater failure — which can cause a crew rest facility to become cold-soaked — as a problem that can interfere severely with sleep if crewmembers have to be displaced to business-class seats in the cabin during ULR operations. Airlines similarly should be vigilant for humidifier failures and intrusive noise from loose equipment.

An influential 1998 standard issued by the Australian and International Pilots Association gives resting pilots the choice of a private reclining seat or bunk at all times.

Wake-Up Calls

A U.S. voluntary safety reporting system contains examples of how some crews have handled problems involving a crew rest facility. In one, the captain designated as aircraft commander and one of the two first officers on a 777 were summoned from the crew rest facility to the flight deck during a long-range international sector. The captain later said, "Approximately three hours after takeoff … the on-duty flight deck crew observed fire and smoke coming from the lower right corner of the first officer's windscreen. The first officer [on duty] turned the window heat [to] 'OFF' for that pane while the captain [on duty] grabbed the Halon fire extinguisher. The flames subsided, and it was not necessary to discharge the extinguisher. … Residual smoke penetrated all areas of the cabin, crew rest areas and cockpit. I was notified of the event by the 'flight leader' (flight

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attendant in charge), and was told that we were diverting. My [first officer] and I entered the cockpit and put on our full-face oxygen mask [and] goggles. … A normal [overweight] landing was made with minimum sink rate."[4]

Emergency alert/communication systems and emergency egress procedures can come into play. "I received a report from a flight attendant in the aft crew rest area that he and two others had been awakened by fumes," said the captain of a 747-400. "He said the fumes had an electrical and/or sulfur-type smell. I secured the upper deck with additional [flight attendants positioned as guards and] sent the [pilot not flying (PNF)] to inspect and wake one of the pilots in the pilot crew rest area. … We were unable to determine the source of the fumes [in an electrical distribution panel or] eliminate the fumes from the cabin. … An emergency was declared and a timely diversion … was accomplished."[5]

Suspicion of a problem also has prompted immediate investigation of conditions in the crew rest facility. In one example, the captain of a 777 said, "Climbing through approximately Flight Level 230 [about 23,000 ft] we received [the engine indicating and crew alerting system] message 'SMOKE CREW REST F/D.' … [One] first officer went back to inspect the forward crew rest area and forward cabin. Shortly after she did so, we received a call from the purser that there was easily visible gray-white smoke in the forward cabin. … We were given a clearance to jettison fuel during descent [and diversion]. … A smooth, normal landing was achieved [and] passengers were advised to remain seated."[6]

Another example involved disrupting precoordinated sleep. The captain of a 777-200 sent the first officer to the crew rest facility because of suspected food poisoning 2.5 hours after departure on a trans-Atlantic flight. The first officer left and spent the following 90 minutes in the forward lavatory. The report said, "I … asked the [door 2L] flight attendant to wake the [PNF] first officer in the bunk and have her [return to duty] early. She returned to the cockpit within five to 10 minutes. The [ill] first officer spent most of the rest of the flight either in the lavatory or resting in the bunk."[7]

The steering committee encouraged airlines to ensure adequate training about sleep and alertness. Recurrent training also should cover emergency procedures and standard operating procedures for seat belt use in the crew rest facility and any rules on occupancy of the crew rest facility during taxi, takeoff and landing to reduce the risk of severe turbulence or other forces causing injuries.

"Interestingly, facility parameters such as the size of the crew rest facility, the size of the actual bunk and head space were rated, on average, as having little effect [either promoting or disrupting sleep]," one U.S. research team said. "Dark, quiet surroundings and a comfortable temperature and sleep surface are key elements for a sleep-conducive environment. … Finally, and perhaps most importantly, education can play a valuable role in maximizing the benefits of crew rest facilities."[8] ●

© Airbus

The crew rest facility for flight attendants, as on the Airbus A340-500, has proven to be a key element of fatigue risk management systems.

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The Clotting Factor

New studies confirm a link between DVT and long-haul flights but show that, for most people, the risk of developing such blood-clotting disorders is slight.

BY LINDA WERFELMAN

The risk of developing deep vein thrombosis (DVT), pulmonary embolism and related blood-clotting problems doubles after flights of more than four hours and continues to increase as the duration of the flight increases — or if an individual makes multiple flights within a short time period, the United Nations World Health Organization (WHO) says.[1]

Even so, the results of the first phase of the WHO Research Into Global Hazards of Travel (WRIGHT) project indicated that, among healthy individuals, the risk of developing these problems is relatively low — a probability of about one in 6,000 — for anyone who is seated and immobile for more than four hours.

The project is studying occurrences of several ailments, known collectively as venous thromboembolism (VTE), whose two most common forms are:

- DVT, in which a thrombus, or blood clot, forms in a "deep" vein in the leg — a major vein that carries blood up the legs and back to the heart, as opposed to a "superficial" vein directly beneath the skin (see "How Blood Clots," p. 43). Symptoms typically include pain in the affected leg, swelling and discoloration of the leg and unusual warmth in the skin. In some cases, however, there are no symptoms; and,

- Pulmonary embolism, in which a piece of a blood clot, called an embolus, from a DVT breaks off, travels through the blood vessels to the lungs and lodges there, blocking the flow of blood. Symptoms include chest pain, difficulty breathing and a cough. This is the most serious complication of DVT and, if untreated, can lead to death.

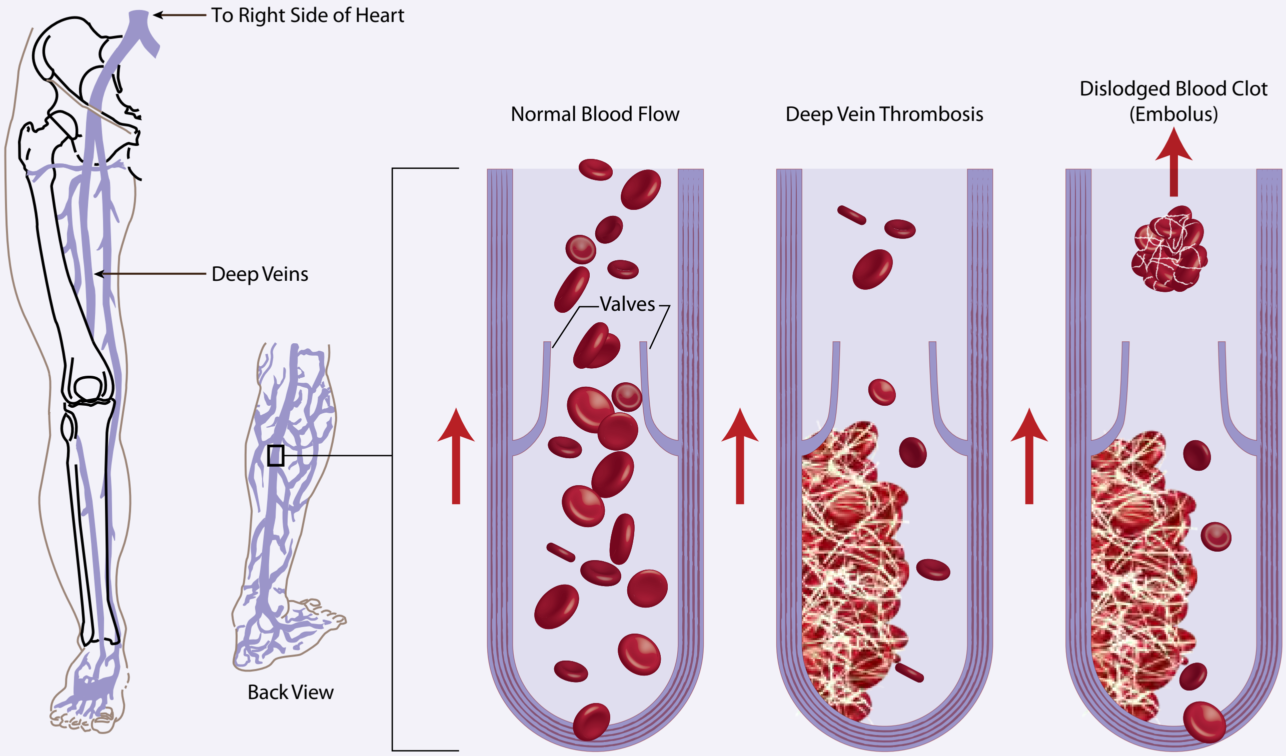
How Blood Clots

Blood usually clots as part of the healing process after a blood vessel is cut or otherwise damaged. Disc-shaped cells called blood platelets collect at the site of the injury, where blood proteins called clotting factors help trap the platelets in a clot that prevents further blood loss.

In deep vein thrombosis (DVT), the clotting process occurs in the wrong place — inside a vein, usually in the lower leg. Small clots usually dissolve before they cause damage, but larger clots — those that develop in major veins in the leg can be several inches long — may break apart and travel through the bloodstream.

If these fragments become lodged in the lungs — in a condition known as pulmonary embolism — they can result in chest pain, shortness of breath and, if the condition is untreated, death.

— LW



Source: Stanley R. Mohler, M.D./U.S. National Institutes of Health

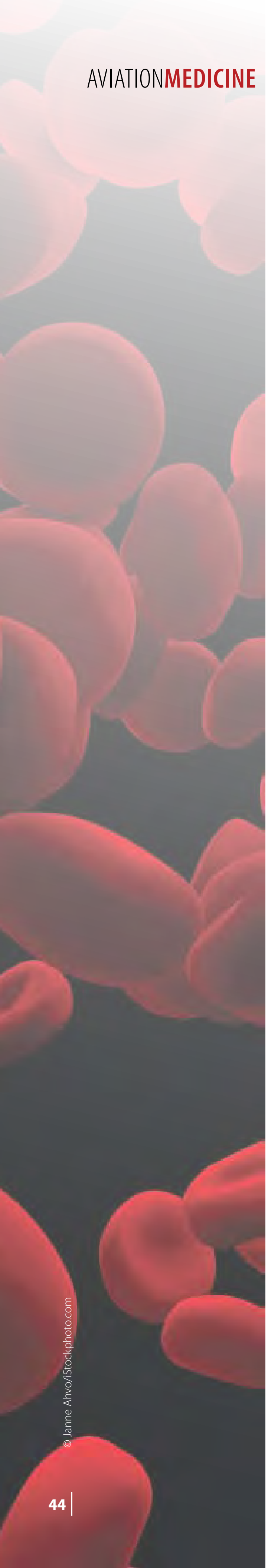
The project's first phase comprised five studies, designed to determine the incidence of VTE among the general population, among passengers and among pilots; the effects, if any, of exposure to the low-air-pressure environment of an aircraft cabin and on development of VTE; and what factors might be associated with development of VTE during flight.

"The combined results from these studies provide a consistent picture in line with previous reports, which highlighted the possible link between air travel and VTE, and a similar association for other types of travel," the report said.

"The findings … demonstrated that the increased risk of VTE observed in long-haul travelers is due mainly to prolonged immobility. It is possible that there is an interaction between pre-existing risk factors and flight-specific factors, which may further increase the risk during air travel. In view of the substantial number of people undertaking long-haul air travel and the fact that many travelers will have one or more known or unknown risk factors for thrombosis, air travel-related VTE is an important public health issue."

'SIT Syndrome'

DVT is not restricted to people who spend long stretches of time in aircraft — or even to those traveling in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other modes of transportation, such as train, bus or automobile. It occurs among people with specific risk factors, especially when those risk factors are combined with limited mobility.

For example, researchers from the Medical Research Institute of New Zealand found that office workers were at risk from an ailment they characterized as "seated immobility thromboembolism" (SIT) syndrome.[2]

"There are considerably more people who are seated for long periods at work as part of their normal day than there are traveling," lead researcher Richard Beasley said.[3]

A 2005 study involved 62 hospital patients suffering from blood clots; 34 percent had been at work, seated, for long periods, before developing the ailment, compared with 1.4 percent who had recently traveled on long-haul flights. All of the patients were older than 40 and had a history of "regular seated immobility of at least eight hours" with no other recognized risk factors.

Risk Factors

DVT occurs when one of several factors is present:[4]

- Decreased blood flow, often caused by poorly functioning valves in the veins or by inactive muscles in the affected part of the body;
- Injury to a vein, sometimes caused by a bone fracture or by external pressure;
- Increased blood clotting, resulting from clotting disorders, from some medications such as oral contraceptives or similar hormones, or from some illnesses such as cancer; or,
- Genetic or environmental risk factors, such as overweight, personal or family history of VTE, varicose veins and smoking. In addition, VTE is especially likely among people over age 40 and among those who are very tall — more than 1.9 m (75 in) — or very short — less than 1.6 m (63 in).

VTE affects passengers far more frequently than flight crewmembers, although pilots have — very rarely — developed the problem during flight.

A report in the *Indian Journal of Aerospace Medicine* described the case of a 59-year-old senior airline pilot with more than 12,000 flight hours, who experienced "mild swelling" of his left ankle about four hours into a long-haul flight in April 2003.[5]

"Over the next six hours, the swelling gradually increased from the ankles to involve the entire left leg, accompanied by a nagging pain," the report said.

After landing, he was admitted to a hospital, where tests showed "extensive" DVT. The pilot was treated with anticoagulants. When the report was published later in 2003, the pilot still had swelling of the lower third of his left leg, continued to take anticoagulant medication and wore a compression stocking to prevent the pooling of blood in the lower leg.

"There were no risk factors in the case [and no] abnormality was detected in the coagulation studies," the report said. "DVT and life-threatening pulmonary embolism should be added to the list of causes for pilot incapacitation. The risk of repeat episodes of DVT, development of [side effects] and the continuing anticoagulant therapy make it difficult to re-flight the aircrew."

One of the WHO project's studies involved 2,499 Dutch commercial pilots (96 percent of whom were male, with an average age of nearly 36 years) who were observed for 10,165 person-years; during that time, six cases of VTE were diagnosed — a rate similar to that of the general Dutch population. The study found no association between the occurrence of VTE and the number of hours flown.

"Although these results excluded a high risk of thrombosis in pilots who fly very frequently, a mildly increased risk could not be ruled out since it is difficult to estimate the expected rate of VTE for this exceedingly healthy group," the WHO report said.

A Hypoxia Link?

Another of the WHO project's studies found no connection between development of DVT and the hypobaric hypoxia — low blood oxygen levels caused by low cabin pressure — that would be found in the cabin of a commercial airplane.

In the study, conducted from 2003 to 2005 in the United Kingdom, 73 healthy volunteers were seated, in eight-hour sessions at least one week apart, in pressure and oxygen conditions that would be experienced in an airplane with a cabin pressure of 8,000 ft, as well as in those that would be experienced at "ground level," the WHO report said.

"The results of the hypobaric chamber studies with healthy volunteers predominantly without risk factors for VTE failed to demonstrate any association between hypobaric hypoxia (of a degree that might be encountered during commercial air travel) and prothrombotic alterations in the [blood] system," the WHO report said.

A "travel and non-travel immobility study" included in the WHO project found that some factors related to the airplane environment "flight-specific factors" may interact with existing risk factors in an individual to cause "increased coagulation activation in susceptible individuals over and above that related to immobility," the report said.

The study, conducted in 2004, involved 71 healthy volunteers, some of whom had an inherited blood-clotting disorder known as the Factor V Leiden mutation and/or used oral contraceptives. Results of the study indicated that "one or more flight-associated factors, possibly hypobaric hypoxia or the type of seating in the airplane, lead to increased thrombin [a blood enzyme that promotes clot formation] generation after air travel in some individuals, especially those with the Factor V Leiden mutation who also took oral contraceptives," the report said.

The next phase of the WHO project is designed to further explore the possibility that an interaction between pre-existing risk factors and flight-specific factors may increase the possibility of developing DVT, as well as to identify effective prevention measures.

"There is a clear need for travelers to be given appropriate information regarding the risks," the report said.

Existing recommendations from WHO and other organizations advise people with one or more risk factors to consult their doctor or a travel medicine specialist before any flight that will last three hours or longer.[6]

For travelers without risk factors, however, recommendations emphasize frequent exercise for the legs and feet (see "Preventing DVT").

"It is thought that exercise of the calf muscles can stimulate the circulation; reduce discomfort, fatigue and stiffness; and … may reduce the risk of developing DVT," WHO guidelines say.

As long flights have become more common, many airlines have increased their emphasis on passenger exercise. For example,

Preventing DVT

Guidelines for preventing deep vein thrombosis (DVT) and related blood-clotting disorders in airplane passengers include:[1,2]

- Stay active. Walk around the airplane cabin every two to three hours. Exercise the feet and legs — rotate the ankles, flex the feet and raise the legs — every hour. Many airlines provide passengers with diagrams of suggested exercises;
- Stay well hydrated. Drink water and juice, and avoid alcoholic and caffeinated beverages, which are associated with dehydration;
- Avoid sitting with crossed legs. This position compresses the veins in the backs of the legs, increasing susceptibility to blood clots;
- Wear loose-fitting clothing during flight, and avoid stockings with tight elastic bands below the knees; and,
- Avoid medications that can induce long periods of sleep.

— LW

Notes

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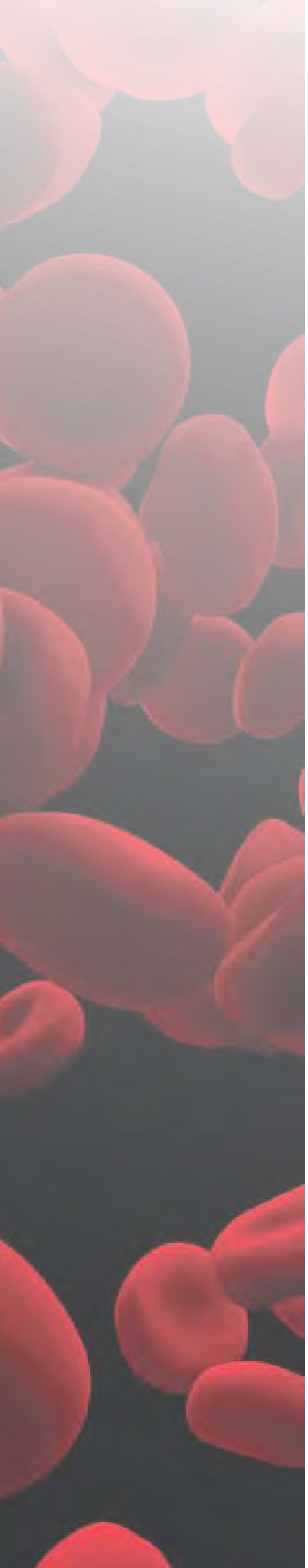

Singapore Airlines — which operates flights as long as 18 hours — and other airlines provide advice cards at every seat that contain diagrams of recommended leg/foot exercises to be performed at regular intervals; flight attendants also periodically prompt passengers to do their exercises or move around the airplane.[7]

Other airlines, including British Airways, have posted information on their Web sites describing the risk factors for DVT and recommendations for in-flight activities to reduce risks of developing problems. Similar information is printed in the in-flight magazine and presented on the in-flight entertainment system.[8]

Travelers should consult their doctors before trying several suggestions that might help some passengers and result in serious side effects for others. Among these suggestions are:

- Wearing compression stockings, which some researchers say might reduce the incidence of DVT for some passengers, but only if they are fitted properly; and,
- Taking aspirin, which has been one of the most controversial issues associated with DVT. Its use is recommended by some medical specialists but cautioned against by others, who warn that it could lead to stomach irritation or gastrointestinal bleeding.

Other blood-thinning medications, such as heparin, sometimes are prescribed for people in high-risk groups. Specialists disagree on how it should be used against travel-related DVT, although many prescribe injections of the medication beginning the day before a flight and ending the day after.[9] However, health authorities, as well as the manufacturer, have warned that, in some cases, heparin might be associated with the development of blood clots in the weeks after an individual stops taking it.[10]

If a passenger or crewmember develops DVT, prompt medical attention is necessary.

DVT can occur as long as one month after travel — sometimes longer. During the post-travel period, individuals who experience swelling in the legs, muscle cramping or changes in skin color should seek medical attention. ●

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Teamwork in Motion

Flight crews play a pivotal role in safety during business jet towing and parking.

BY WAYNE ROSENKRANS

Aircraft damage that delays or cancels flights prompted Dassault Falcon Customer Service in France to investigate causal links between aircraft towing and ramp accidents. The company's data analysis in early 2007 confirmed that such events are a major cause of flight schedule disruptions.

"Most events are preventable: Systematic precautions, patience and careful handling may avoid personnel injury and expensive repairs," Dassault said in a service advisory.[1] "These best practices are applicable to any personnel using a vehicle in the vicinity of an aircraft such as a tug, truck, limousine, airport vehicle, etc."

Events from the first quarter of 2000 through the first quarter of 2007 were used to develop the advisory and to help raise industrywide awareness. "The 68 events studied are the number of occurrences for which we had a sufficiently detailed description of the event for our analysis," says Pascale Heitz, Falcon 900-series support program manager. The importance of avoiding such events was emphasized by the fact that 44 events (65 percent) occurred away from the operators' home bases, where the consequences are more difficult to handle.

An internal alerting system sounded the alarm when delayed/cancelled flights for the Falcon fleet increased after 2003 to an overall rate of about 10 towing/parking events per year. "In the last 12 months, towing incidents have been the number one cause of delayed/canceled flights on the Falcon 900EX EASy aircraft, with three occurrences out of the approximately 70 aircraft in service," Heitz said.

Heitz believes that the problems should receive wider attention for several reasons. "The trend most probably is similar for other business jets, as most events occur outside home base — that is, generally involving a tow vehicle not maneuvered by the Falcon operator — and the number of towing incidents involving two aircraft was significant," she said.

When towing/parking events occur, immediate consequences can include the need for extensive repairs in an urgent aircraft-on-ground scenario, plus a sudden requirement for alternate transportation. "For Falcon aircraft, a substitute airplane costs about US$4,000 per flight hour, so it is a big expense for the operator if the aircraft takes some time to be repaired," Heitz said.

Injuries, while rare, also have been a significant consequence — especially injuries to ground service personnel or bystanders. "We may have to report the event to our airworthiness authorities and follow up to review if we could improve something in our documentation, communication, design or training," she said.

Flight crews add a line of defense against towing mishaps if they not only observe FBO personnel but check their equipment and familiarity with aircraft-specific procedures.

Causal Categories

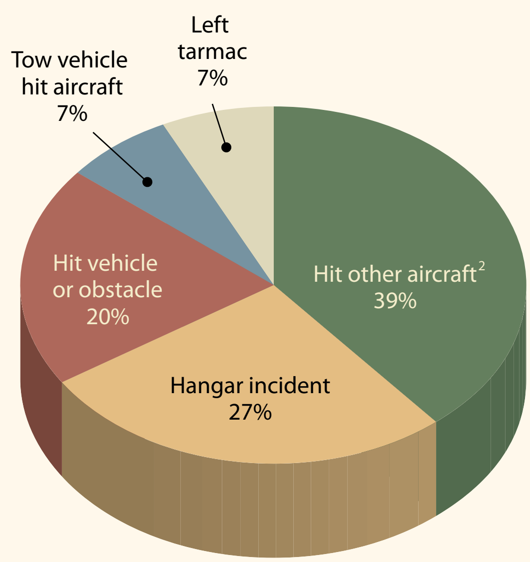
Company analysts assigned the following causal categories:

- The most common example of 24 *maneuvering error* events was a towed aircraft striking a parked aircraft (Figure 1) — often inside a hangar. Variations included the towed aircraft striking the hangar door or a parked vehicle or the tow vehicle striking the towed aircraft, or the tow vehicle operator moving the towed aircraft off the tarmac.

- When the 22 *torque-link connected* events occurred, the nose landing gear leg or the nose-wheel steering system typically was damaged because of failure to disconnect the nose landing gear torque link prior to towing. Falcon aircraft require this step because the turn radius of the gear will be exceeded if the torque link remains connected.

- When the eight *incorrect towbar installation* events occurred, the aircraft typically struck the tow vehicle. In one example, the towbar was not secured to the tow vehicle, so it dropped out of position when towing began.

Maneuvering Errors During Towing[1]



Notes

1. Maneuvering errors that occurred during towing of Dassault Falcon aircraft were identified in the manufacturer's worldwide report database from first quarter 2000 through first quarter 2007. A total of 68 towing/parking events in the database were deemed to have sufficient detail for categorization and safety analysis.
2. Assigned subcategories of maneuvering error were: *hit other aircraft,* which means the towed aircraft struck another aircraft that was parked, and damaged parts often were the wing tips, but sometimes were the horizontal stabilizer tip, gear door, etc.; *hangar incident,* which means all events occurring in a hangar, including striking another aircraft, and in most cases, the aircraft struck the hangar door or struck another part of the hangar itself; *hit vehicle or obstacle,* which means that the aircraft struck a vehicle such as a car or fuel truck or an obstacle such as a fence; *tow vehicle hit aircraft,* which means any event in which this was the type of contact; and *left tarmac,* which means that the towed aircraft departed from the tarmac because of error by ground personnel.

Source: Dassault Falcon Customer Service

Figure 1

- When the four *broken towbar* events occurred, the issue typically was failure to carefully inspect the towbar condition prior to using it. In one example, the towbar broke into two pieces, and the aircraft then struck the tow vehicle.

- When the four *parking brake left on* events occurred, the aircraft parking brake was not released, and usually the parking brake was damaged.

- When the two *turn radius exceeded* events occurred, the nose landing gear leg or nosewheel steering typically was damaged because on the Falcon 900EX EASy, when the nose gear torque link is not connected, the turn radius is limited to 100 degrees.

- When the one *chocks removed too early* event occurred, the aircraft rolled into another aircraft after the chocks were removed before towing began.

- When the one *improper tug* event occurred, the aircraft rolled into the tug because the tow vehicle selected had insufficient power, causing its towbar shear-pin to break and disconnect from the aircraft.

- When the one *tow vehicle left with brake off* event occurred, the tug rolled away from its initial position with the aircraft still connected, and the towed aircraft struck another aircraft.

- When the one *towbar hit aircraft* event occurred, the tow vehicle operator inadvertently struck the aircraft with the towbar while connecting to the aircraft.

Typical Examples

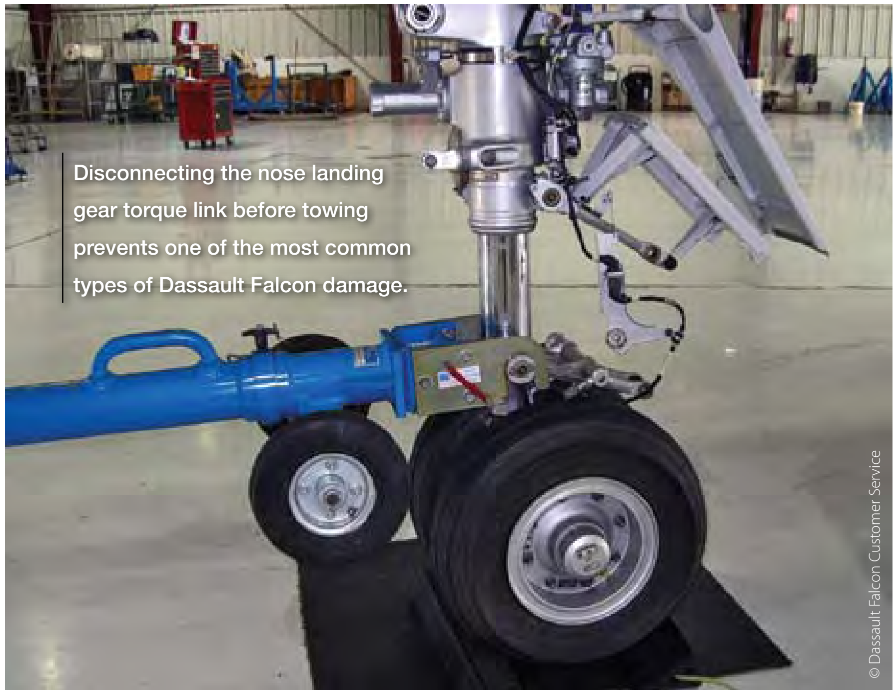
In developing the advisory, the analysts considered these case studies among others:

- "According to the customer, as the aircraft was being pushed back, the aircraft disconnected from the towbar (the towbar head pin had not been installed). The disconnect happened when the tug's brakes were applied to stop the aircraft. Upon disconnect, the customer's aircraft continued to roll toward another parked aircraft. The tug driver jumped off the tug and put a chock under the Falcon's tire path; this stopped the Falcon. Unfortunately, the tug continued to roll toward the Falcon. Seeing this, the tug driver tried to stop the tug but was unable to. The tug rolled into the nose gear doors on the Falcon."
- "The aircraft was towed with the steering connected. A very sharp turn was made to turn the aircraft around when a 'loud pop' was heard from the nose gear." The operator was reminded to comply with the *Dassault Falcon Ground Servicing Manual* during towing operations and a maintenance procedure to check for any damage following an accident/incident.[2]
- "The aircraft needed to be moved on the ramp. The [flight] crew was not around at the time, and the main entrance door was locked. [The aircraft] was towed approximately 50 yd (46 m) with the parking brake set."

The aircraft crewmember's close involvement is critical in reducing towing/parking events, Dassault believes. "Close involvement" means that the flight crew takes time to check the equipment used by the fixed base operator (FBO), verifies that the FBO's personnel are familiar with the specific towing/parking procedures for the aircraft type, and remains in the vicinity of the aircraft until it has been stopped and chocked on the parking stand. The parking brake may remain released while a Falcon's wheels are chocked, especially for overnight parking. Another recommendation is to verify that safety cones with high-visibility color and retroreflective tape have been placed immediately after parking to attract ramp vehicle drivers' attention.

"A copy of the *Ground Servicing Manual* should always be kept on board the aircraft," the advisory said. Heitz added, "The goal is to reduce the risk by ensuring that the towing personnel are aware of the Falcon towing procedure, providing them with a manual if necessary."

Manuals provide the aircraft-specific towing procedures for use of a shear pin–fitted towbar or a towbarless aircraft tow vehicle.[3] Operators, FBOs and handling agents are strongly discouraged from using practices other than these.


Disconnecting the nose landing gear torque link before towing prevents one of the most common types of Dassault Falcon damage.

Mismatched Equipment

Operators, FBO personnel and handling agents must use only tow vehicles, towbars and shear pins approved by the aircraft manufacturer.[4] "Pins of a lesser strength may shear during normal towing loads," the advisory said. "Use of a stronger pin may cause excessive loads to be applied on the nose gear, and could result in damage." Scheduled maintenance inspections may enable early detection and timely replacement of the unserviceable equipment.

Dassault also recommends carefully inspecting the condition of each towbar and/or shear pin — looking for nicks, bends and other signs of damage — immediately before each towing/parking operation, and avoiding the use of damaged parts. "A damaged pin may fail and cause premature separation of the towbar from the aircraft if subjected to excessive loads," the advisory said.

Correctly matching the tow vehicle to the specific aircraft type and local towing conditions similarly reduces risks. "Check that the tug is powerful enough to maneuver the aircraft at the maximum ramp weight, including factoring in the slope of the tarmac," the advisory said.[5] "If the tug is underrated, the shear pin may break and lead to aircraft damage."

After procedures and equipment serviceability are addressed, the next step is to "clear the towing area of all safety and ground support equipment such as flight line fire bottles, servicing carts, maintenance vehicles, etc.," the advisory said. Depending on the manufacturer's specifications, pre-towing steps may include confirming that the nose landing gear torque link has been disconnected — if applicable — the parking brake has been released and the towbar has been connected properly.

Falcon-specific reminders that may have counterparts for other business jets are:

- Before beginning the towing operation, close the aircraft main entrance door to avoid damaging it by contact with an uneven surface;
- To prevent damage to the nose gear torque link, called the *scissor link* on some other types, do not step on the nosewheel to turn it; instead, "rotate the towbar or pull gently on the lower torque link for alignment";
- To prevent damage to the nose gear tire, ensure that the torque link lower arm does not contact the tire.

Dassault's most widely applicable safety advice includes the following points:

- "Ensure clear communication between cockpit and towing personnel to avoid contradictory actions;
- "Keep qualified personnel in the cockpit during towing to apply the parking brake in case of emergency;
- "Never leave the cockpit while the aircraft is unchocked;
- "Slow down; most towing/parking events are due to rushing, so patience is your best asset for safe towing. Use gradual turns and drive at a slow walking speed. When in doubt, stop;
- "In a cramped area such as a hangar, always assign wing walkers to watch the wing tips. Wing walkers with whistles can help to alert the driver;
- "Take special care inside the hangar when moving aircraft, tow vehicles, limousines and apron service vehicles because a relatively large number of events occur upon hangar door closure, while towing another aircraft inside the hangar, while driving a car inside the hangar, etc.;
- "In rain, snow or fog conditions, visibility is lower and stopping distances are increased. Make gradual turns and steer smoothly in these weather conditions and at night. Use tire chains for the tug as appropriate for snow and ice."

Sharing Best Practices

To address past constraints on communication channels, limited to customers and authorized service centers, a new method for free digital distribution of procedures and checklists is in development. "Today we have a private Internet portal, which is limited to our operators, so we are currently looking into a public address to see if we could provide the *Ground Servicing Manual* on our Web site without a password," Heitz said.

For both general and type-specific safety guidance about towing/parking business jets, Dassault Falcon Customer Service also recommends the U.S. National Air Transportation Association Safety 1st Professional Line Service Training Program <www.natasafety1st.org/plst.htm> and the Flight Safety Foundation Ground Accident Prevention program <www.flightsafety.org/gap_home.html>, which includes free online videos and other instructional materials. ●

Notes

1. Dassault Falcon Customer Service. "Precautions for Safe Aircraft Towing/Parking." *Falcon Service Advisory* no. FSA900EX-EASy-09-10-02. May 21, 2007.
2. *Dassault Aircraft Maintenance Manual* (AMM) MP 09-101 contains the airworthiness checks applicable after a towing/parking event.
3. Operators, ground service personnel and handling agents towing/parking Falcons were referred to Section 5 of the *Dassault Falcon Ground Servicing Manual* and AMM MP 09-100/MP 09-102.
4. The advisory specifies replacement shear pin part no. TMY20-09-105005 for towbar-equipped vehicles and APM2466–2 for towbarless vehicles. Towbarless towing also requires interface tool part no. APM2466 to prevent nose landing gear damage.
5. For example, to tow a Falcon 900EX on level ground, the tow vehicle must have a rated capacity not less than the aircraft maximum ramp weight of 48,500 lb (22,000 kg).

Fewer Fatalities in Hull Loss Accidents

A higher percentage of accidents were nonfatal in 1997–2006 than in the commercial jet era before then.

BY RICK DARBY

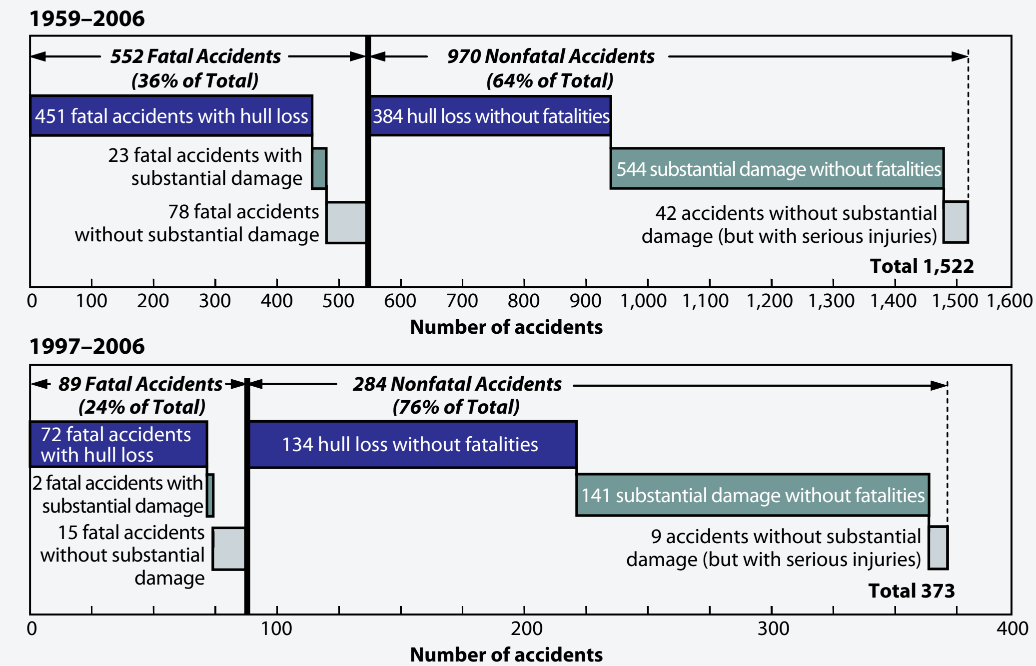
Worldwide commercial jet hull loss accidents less frequently resulted in fatalities in the past 10 years compared with earlier years, according to new data from Boeing.[1]

In the 10-year period through 2006, 134 of 206 hull loss accidents, or 65 percent, were nonfatal (Figure 1).[2] That compared with a nonfatal hull loss rate of 40 percent in 1959 through 1996.

From 1959 through 2006, or roughly the whole jet transport era, 384 of 835 hull losses, or 46 percent, were nonfatal.

Hull Loss Fatalities Down

Accidents by Injury and Damage, Worldwide Commercial Jet Fleet



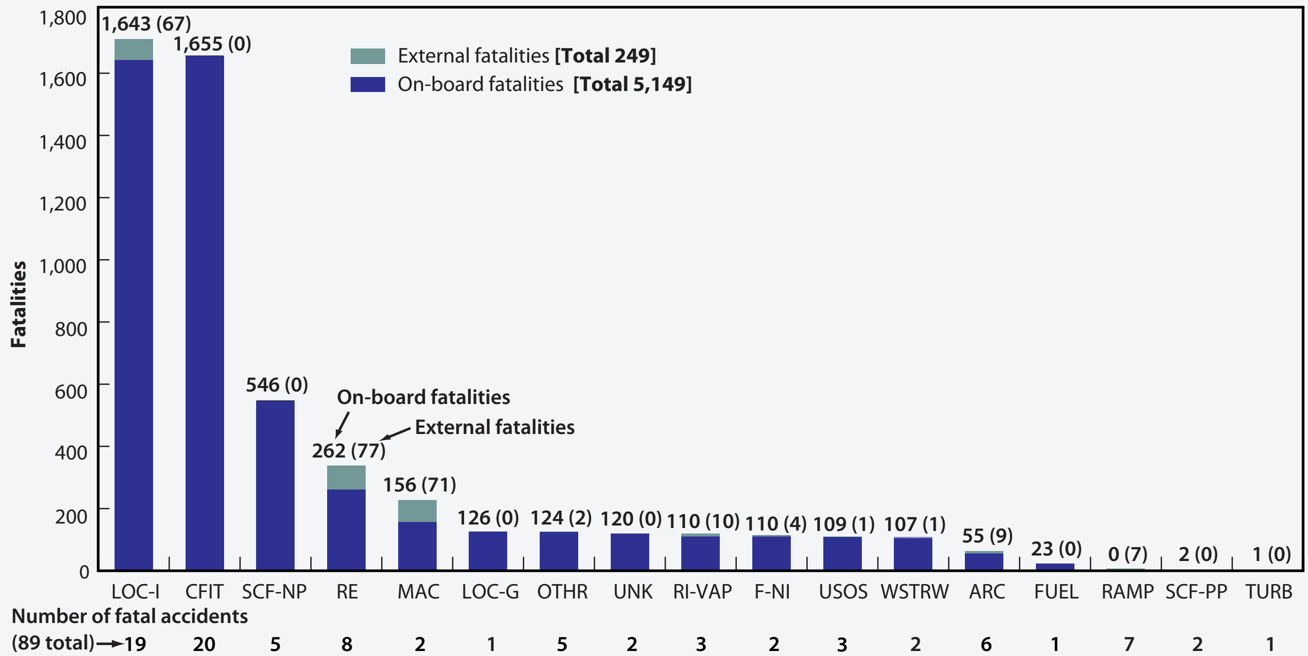
Note: Airplanes manufactured in the Commonwealth of Independent States or the Soviet Union are excluded because of lack of operational data. Commercial airplanes used in military service are also excluded.

Source: Boeing Commercial Airplanes

Figure 1

Loss of Control, CFIT Top Killers As Usual

Fatalities by CAST/ICAO Taxonomy Accident Category, Worldwide Commercial Jet Fleet, 1997–2006



CAST = Commercial Aviation Safety Team ICAO = International Civil Aviation Organization

ARC = abnormal runway contact; CFIT = controlled flight into or toward terrain; F-NI = fire/smoke (non-impact); FUEL = fuel related; LOC-G = loss of control (ground); LOC-I = loss of control (in flight); MAC = midair/near midair collision; OTHR = other; RAMP = ground handling; RE = runway excursion; RI-VAP = runway incursion (vehicle, aircraft or person); SCF-NP = system/component failure or malfunction (non-powerplant); SCF-PP = system/component failure or malfunction (powerplant); TURB = turbulence encounter; USOS = undershoot/overshoot; UNK = unknown or undetermined; WSTRW = wind shear or thunderstorm.
No accidents were noted in the following categories: AMAN = abrupt maneuver; ADRM = aerodrome; ATM = air traffic management/communications, navigation, surveillance; CABIN = cabin safety events; EVAC = evacuation; F-POST = fire/smoke (post-impact); GCOL = ground collision; ICE = icing; LALT = low altitude operations; RI-A = runway incursion (animal); SEC = security related.

Notes: Principal categories are as assigned by CAST. Airplanes manufactured in the Commonwealth of Independent States or the Soviet Union are excluded because of lack of operational data. Commercial airplanes used in military service are also excluded.

Source: Boeing Commercial Airplanes

Figure 2

The percentages of all accidents involving substantial damage to the airplane without fatalities was slightly higher in the recent period, 38 percent, compared with 35 percent in 1959 through 1996. For the 1959–2006 period, the equivalent figure was 36 percent.

Nonfatal accidents in the 1997–2006 period represented 76 percent of total accidents, compared with 64 percent in 1959 through 2006.

The trend lines for annual rates of fatal accidents and hull loss accidents continued in the low, narrow range they have maintained for some 20 years.

The U.S. Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO) Common Taxonomy Team has established standard categories and definitions for aviation accidents.[3] Among fatal accidents during the 1997–2006 period, the two most frequent categories cited were controlled flight into terrain, resulting in 1,655 on-board fatalities, and loss of control in flight, accounting for 1,643 on-board fatalities, each 32 percent of the total (Figure 2).

Table 1 shows that, of the 28 accidents in 2006 listed by Boeing, 19, or 68 percent, occurred

Continued on p. 54.

The Accident Record, 2006

All Airplane Accidents, Worldwide Commercial Jet Fleet

Date	Airline	Model	Accident Location	Phase of Flight	Description	Hull Loss	Fatalities
Jan. 16	Continental Airlines	737-500	El Paso, TX, U.S.	Parked	Mechanic killed during troubleshooting		1
Feb. 7	UPS	DC-8	Philadelphia, PA, U.S.	Initial Approach	In-flight fire	X	
March 4	Air Macau	A321	Macau, China	Tow	Tow bar broke during pushback		
March 4	Lion Air	MD-82	Surabaya, Indonesia	Landing	Nose landing gear damaged	X	
March 18	Air Algérie	737-600	Seville, Spain	Landing	Right main landing gear collapse		
April 19	United Airlines	777-200	Shanghai, China	Descent	TCAS avoidance maneuver		
May 3	Armavia	A320	Sochi, Russia	Final Approach	Struck sea in bad weather	X	113
May 30	Shuttle America	EMB 170	Chantilly, VA, U.S.	Landing	Gear-up landing		
June 4	Arrow Cargo	DC-10	Managua, Nicaragua	Landing	Runway overrun	X	
June 7	TradeWinds Airlines	747-200SF	Medellin, Colombia	Takeoff	Runway overrun	X	
June 9	Asiana Airlines	A321	Seoul, Korea	Cruise	Severe thunderstorm		
June 15	TNT Airways	737-300SF	East Midlands, U.K.	Landing	Right main landing gear damage	X	
June 16	VARIG	MD-11-P	Brasilia, Brazil	Landing	Center main landing gear fracture		
June 23	AMC Airlines	MD-83	Juba, Sudan	Landing	Runway overrun	X	
July 9	S7 Airlines	A310	Irkutsk, Russia	Landing	Runway overrun	X	126
July 28	FedEx	MD-10-10F	Memphis, TN, U.S.	Landing	Left main landing gear collapse	X	
Aug. 27	China Eastern Airlines	A320	Beijing, China	Tow	Pushback collision		
Sept. 7	DHL Aviation	727-200F	Lagos, Nigeria	Landing	Runway overrun	X	
Sept. 9	KLM Royal Dutch Airlines	MD-11-P	Amsterdam, Netherlands	Landing	Foreign object damage		
Sept. 14	FedEx	MD-11-F	Subic Bay, Philippines	Landing	Tail strike		
Sept. 29	GOL Linhas Aereas	737-800	Peixote Azavedo, Brazil	Cruise	Collision at Flight Level 360	X	154
Oct. 3	Mandala Airlines	737-200	Tarakan, Indonesia	Landing	Runway overrun	X	
Oct. 10	Atlantic Airways	BAe 146	Stord, Norway	Landing	Runway overrun	X	4
Oct. 29	ADC Airlines	737-200	Abuja, Nigeria	Initial Climb	Crash shortly after takeoff	X	97
Nov. 10	AirTran Airways	717-200	Memphis, TN, U.S.	Taxi	Runway excursion		
Nov. 17	Cielos Airlines	DC-10	Barranquilla, Colombia	Landing	Nose landing gear collapse	X	
Nov. 18	Aerosucre Colombia	727-100F	Leticia, Colombia	Final Approach	Hit a communication tower	X	5
Dec. 24	Lion Air	737-400	Ujung Pandang, Indonesia	Landing	Runway excursion	X	
28 Total Accidents							**498 on-board. Two external.**

TCAS = Traffic-alert and collision avoidance system

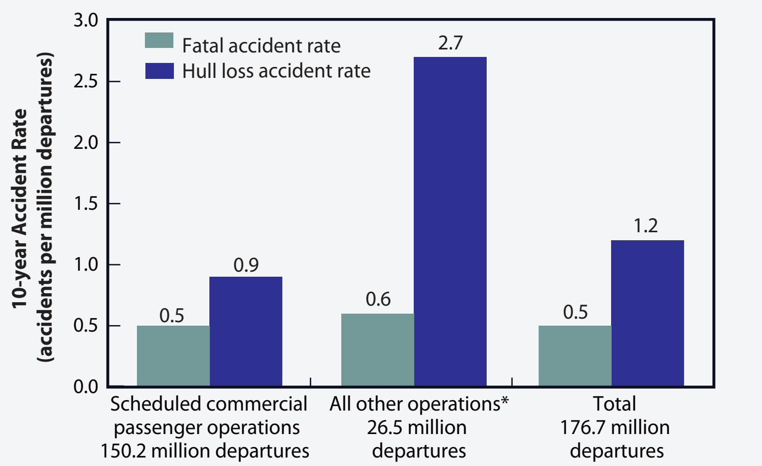
Note: Airplanes manufactured in the Commonwealth of Independent States or the Soviet Union and commercial airplanes used in military service are excluded.

Source: Boeing Commercial Airplanes

Table 1

Fatal Accident Rate Similar Across Operational Types

10-Year Accident Rates by Type of Operation, Fatal and Hull Loss Accidents, Worldwide Commercial Jet Fleet, 1997–2006



* Charter passenger, charter cargo, scheduled cargo, maintenance test, ferry, positioning, training and demonstration flights.

Note: Airplanes manufactured in the Commonwealth of Independent States or the Soviet Union are excluded because of lack of operational data. Commercial airplanes used in military service are also excluded.

Source: Boeing Commercial Airplanes

Figure 3

during the approach or landing phases. The year's seven fatal accidents included four approach-and-landing accidents.

The rate of fatal accidents involving scheduled commercial passenger operations was slightly lower than the rate for all other operations in the 1997–2006 period (Figure 3).[4] The hull loss accident rate was three times higher in all other operations than scheduled commercial passenger operations.

The methodology of Boeing's annual statistical summary, which is widely used by aviation safety professionals, has been updated for the 2006 summary. Differences in definitions between those of ICAO and the U.S. National Transportation Safety Board are pointed out. There is more emphasis on fatal accidents and less on hull loss accidents; the summary says that CAST uses fatal accidents as its metric, and that hull loss has become less useful as an indicator of accident severity.[5] An aging fleet and the high cost of repairs mean that more accidents are write-offs, the summary says.

"The Accidents by Primary Cause chart has been eliminated," the summary says. "Many investigating authorities do not assign a primary cause. Assigning a 'primary cause' can oversimplify the complexities of the aviation system and can therefore be misleading."

The comparison of accident rates by "generations" of airplane types has been dropped, on the grounds that many factors other than time elapsed since introduction of a type were significant. ●

Notes

1. Boeing Commercial Airplanes. *Statistical Summary of Commercial Jet Airplane Accidents: Worldwide Operations, 1959–2006.* Available via the Internet at <www.boeing.com/news/techissues>.

2. An *accident* is defined as "an occurrence associated with the operation of an airplane that takes place between the time any person boards the airplane with the intention of flight and such time as all such persons have disembarked, in which: death or serious injury results from being in the airplane, or direct contact with the airplane or anything attached thereto, or direct exposure to jet blast; or the airplane sustains substantial damage; or the airplane is missing or completely inaccessible." Accidents involving test flights or hostile actions such as sabotage or terrorism are excluded.

   A *hull loss* is defined as an airplane totally destroyed, beyond economic repair, missing or completely inaccessible.

3. A complete description of the taxonomy can be found at <www.intlaviationstandards.org>.

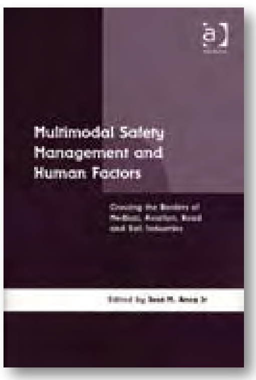
4. A *fatality* is defined as any injury that results in death within 30 days of the accident.

5. Flight Safety Foundation has departed from the use of *hull loss* and *total loss* in defining the most severe type of aircraft accident, on the basis that these terms derived from manufacturer and insurer data are not the best criteria for aviation risk analysis. The Foundation now uses *major accident*, in which any of the following three conditions is met: The aircraft is destroyed; there are multiple fatalities; or there is at least one fatality, and the aircraft is substantially damaged.

   Jim Burin, FSF director of technical programs, said, "The use of the major accident classification criteria ensures that an accident is not determined by an aircraft's age or by its insurance coverage, and it gives a more accurate reflection of the high risk areas that need to be addressed" (*ASW*, 2/07, p. 21).

Safety à la Mode

'Multimodal' safety management can help different industries learn from one another's studies.



BOOKS

Multimodal Safety Management and Human Factors: Crossing the Borders of Medical, Aviation, Road and Rail Industries

Anca, José M. Jr. (editor). Aldershot, England, and Burlington, Vermont, U.S.: Ashgate, 2007. 356 pp. Figures, tables, references, index.

Considered only in terms of specific "fixes," risk reduction measures among the industries, or "modes," listed in the book's subtitle would seem more different than alike. But looking at guiding principles, the underlying similarities become more apparent, as do the opportunities for interdisciplinary learning.

"The multimodal format provides understanding and contrasts far beyond what focus on a single domain could offer," says Robert L. Helmreich, Ph.D., a human factors researcher, in his foreword. "Those with experience in one will gain insights into the breadth of human factors and safety concepts through exposure to the dominant issues in the others."

The book is divided into four sections: "Multimodal Characteristics of Safety Management Systems," "Safety Management Metrics, Analysis and Reporting Tools," "Normal Operations Monitoring and Surveillance Tools," and "The Modality of Human Factors: Exploring the Management of Human Error." Most chapters are based on experimental studies.

Sample provocative comments include the following:

- "Moving Up the SMS Down Escalator": "I define a safety management system [SMS] as the process of removing what is out of date (obsolete) and installing what is up to date (new). It is change in terms of safety philosophies, policies, procedures and practices. … You can be aggressive and make changes rapidly (on the leading/bleeding edge), or you can be conservative and make changes slowly (and risk becoming antiquated). As soon as changes stabilize (one day, one week, one month, one year), the process of evaluating how the changes worked can begin."

- "Governance and Safety Management": "Whilst management may espouse that the company employs a 'can-do' approach to its business, it is often not stated that this means safely and in a compliant manner. Consequently, those at the workplace level may interpret 'can-do' as 'must-do,' even if this means employing workarounds by taking shortcuts in procedures and processes. … Whilst these workarounds are employed with good intent, they pose significant risks to the organization that may not be apparent to those engaged in the tasks at the time."

- "Effects of Flight Duty and Sleep": "Flight and duty [time] limitations are designed to ensure that pilots are not exposed to unacceptable levels of fatigue through maximum shift lengths and minimum rest breaks. As previous research suggests, however, a pilot's experience of fatigue appears not only to be based on their work/rest history but on the amount of sleep they have been able to obtain between and during duty periods."

- "Drought in Safety Management": "We must become even smarter with flight safety and not let the 'new age' complexities of life beat us at our own game. When I fail someone during a flight test it is because they did not meet the standard. I am not trained to know if they had a deprived upbringing. Trainee pilots we see today are understandably part of the new generation. Their schooling probably contained much information on their rights, and what the world owed them, none of which gets to the basics of aviation discipline."

REPORTS

Voluntary Aviation Safety Information-Sharing Process: Preliminary Audit of Distributed FOQA and ASAP Archives Against Industry Statement of Requirements

Chidester, Thomas R. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-07/7. Final report. April 2007. 14 pp. Figures, table. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/index.cfm> or from the National Technical Information Service.*

The Voluntary Aviation Safety Information-Sharing Process (VASIP) is based on developing a technical process to extract de-identified safety data from any participating airline flight operational quality assurance (FOQA) program or aviation safety action program (ASAP), aggregate the data and make them accessible to industry stakeholders.

In 2004, the FOQA and ASAP Aviation Rulemaking Committees (ARCs) identified the U.S. National Aeronautics and Space Administration (NASA) as having the needed background, resources and personnel to provide technical aggregation and the analytical tools to support the process. NASA was asked to create a network of servers located on airline premises to be accessed by NASA for aggregation, statistical analysis and summarization. Summaries in electronic format are returned to each airline's local server for archiving.

Under NASA's leadership, a partnership of participating airlines, employee organizations and FAA representatives defined the components of FOQA and ASAP data archives, as well as a set of functional requirements for archive development. They were approved by the FOQA and ASAP ARCs, and when the basic infrastructure was deployed in January 2006, data archiving began at the participating airlines.

The report "audits the hardware, software and networking infrastructure against the original functional specifications provided by the ARCs to NASA," the report says. "Auditing was accomplished by monitoring NASA's functional testing and demonstration of archive hardware from November 2005 through April 2006, and during a site visit in May 2006 to review functions that had not been demonstrated at previous meetings."

The report concludes, "Hardware, software and networking have been implemented in a manner that supports the functions requested by the FOQA and ASAP ARCs in the fall of 2004." The infrastructure can be expanded to additional airlines, but "it will be necessary to drive down some costs and assess how costs of added operators will be allocated," the report said.

WEB SITES

Helicopter Association International (HAI), www.rotor.com

HAI says on its Web site that it is "dedicated to the advancement of the international helicopter community." Even though HAI primarily serves its members, it provides considerable information to nonmembers.

The publications section of the Web site describes videos, CDs, DVDs, books and other publications, and safety posters focusing on helicopters and safety. Some are free online; members and nonmembers can purchase others. HAI's separate video library contains numerous videos free online, with titles such as *The Vertical Dimension*, *Flying in the Wire Environment* and *2007 Heli-Expo*.

Comparative accident and safety statistics for U.S. civil helicopters are available free to be opened as PDFs or, in some cases, Microsoft® Excel files. Safety trends are charted for different segments of the industry (e.g., commercial air tour operations, air medical services and air taxi services).

News stories about safety, security and "helicopters saving lives," industry and government news and alerts, and regulatory information issued by civil aviation authorities appear in full-text format. Software is available to translate English-language Web pages into 14 other languages.

A long list of helicopters, by types, is given with links to specifications and photos. Similarly, a lengthy list of safety-related organizations has links to their respective Web pages.

Civil Air Navigation Services Organisation (CANSO), www.canso.org

CANSO identifies itself as "the global voice of the companies that provide air traffic control." As one of its objectives, "CANSO acts as the global ANSP [air navigation service provider] voice on both regulatory and industry issues and coordinates closely with representatives of both sides."

The publications section of the Web site offers significant amounts of information to nonmembers. The public has access to the following:

- "Human Factors in Safety Management: The New View," a movie produced by DFS (Deutsche Flugsicherung), the air traffic control provider in Germany, which discusses human factors and just culture, and is available online in a seven-minute short version at no charge. Instructions for obtaining the full version are provided.

- Current and archived issues of its journal, *CANSO News*, which are free and may be read online, printed or downloaded, as are issues of *ATM News*, a twice-monthly newsletter, covering global air traffic and navigation news. *ATM News* is now available in Russian. CANSO's *Update Europe*, a bi-monthly newsletter, focuses on European activities. The latest issue contains highlights of the recent European just culture conference.

- Numerous CANSO and industry presentations, speeches, publications and reports that are listed and linked to the full-text documents. ●

Source

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— *Rick Darby and Patricia Setze*

Go-Around Decision Delayed

Wing tip struck the runway before the descent was arrested.

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

Airplane Was Not Aligned With the Runway

McDonnell Douglas MD-83. Minor damage. No injuries.

The flight was inbound with 140 passengers from Anchorage, Alaska, U.S., to Fairbanks, where reported weather conditions included a 2,300-ft broken ceiling, 10 mi (16 km) visibility and surface winds from 250 degrees at 6 kt the afternoon of May 18, 2006. The flight crew was cleared by air traffic control (ATC) to conduct the VOR (VHF omnidirectional radio) approach to Runway 19R. The first officer was the pilot flying.

When the airplane descended below the clouds, the first officer requested and received permission from the captain to continue flying the instrument approach procedure for proficiency purposes, said the U.S. National Transportation Safety Board (NTSB) report.

The final approach course is 220 degrees, and a left turn is required for landing on Runway 19R, which is 11,800 ft (3,597 m) long. The captain told investigators that, as the airplane neared the airport, he observed the precision approach path indicator lights for the parallel runway, 19L. "The first officer initially saw Runway 19L [which is 6,500 ft (1,981 m) long] while still above the MDA [minimum descent altitude] and 3 mi [5 km] from the field," the captain said. "I pointed out Runway 19R."

The report said that the airplane was left of the centerline when it crossed the approach end of Runway 19R, and the first officer applied right aileron control to correct the misalignment. "The captain then gave the order to go around, and takeoff engine power was applied, but the airplane's descent continued, and the right wing struck the runway as the main landing gear wheels contacted the runway," the report said.

The pilots were not aware that the wing had struck the runway until they were informed by a flight attendant seated in the rear of the airplane. "After the go-around, the flight crew declared an emergency and made an uneventful landing on Runway 19R," the report said.

NTSB said that the probable cause of the incident was "the flight crew's delayed go-around during an unstabilized approach to land."

Second Officer Suffers Seizure

Airbus A330-300. No damage. No injuries.

Three pilots were aboard the A330 for a scheduled flight from Hong Kong to Sydney, Australia, on Jan. 10, 2007. When the airplane was near Cairns, Queensland, with about 2.5 hours of flight remaining to Sydney, the pilot-in-command (PIC) and the second officer were at the controls, and the copilot was in the crew rest area, the Australian Transport Safety Bureau report said.

The PIC realized that the other pilot was no longer participating in a conversation. "The [PIC] noticed that the second officer had sighed a couple of times and that his left fist was tightly clenched," the report said. "He did not respond to touch, and foam had formed around one side of his mouth."

The PIC requested assistance from cabin crewmembers, who removed the second officer from the flight deck and took him to the crew rest area. The copilot replaced the second officer at the controls. A cabin crewmember qualified as a nurse provided initial medical attention to the second officer.

"A medical practitioner, who was a passenger on the aircraft, was requested to provide an assessment of the second officer's medical condition," the report said. "The medical practitioner was able to seek further advice through radio contact with the airline's medical center. … The second officer was deemed to not require further immediate medical attention, so the [PIC] elected to continue on to Sydney."

After landing, the second officer was transported by ambulance to a hospital, where he was diagnosed as having suffered a neurological seizure.

The report said that the second officer had recently returned to flight duty following an extended period of sick leave. He had suffered a seizure in May 2006, and his first-class medical certificate had been suspended by the Australian Civil Aviation Safety Authority (CASA) pending neurological assessment. At the time, the second officer had no previous history of seizures.

"The second officer subsequently underwent detailed neurological testing, assessment and monitoring," the report said. "Medical specialist advice to CASA was that the initial event, which was diagnosed as a provoked or acute symptomatic seizure, was likely to be the result of a coincidence of a number of factors. … The prognosis was that there was minimal risk of any recurrence." Based on this information, CASA reinstated the second officer's first-class medical certificate in January 2007 with the requirement that a neurologist's report accompany any subsequent request for renewal.

"Upon receipt of information confirming that the pilot had suffered a second neurological seizure, CASA revoked the pilot's medical certificate," the report said.

Commander Misunderstands Docking Aids

Boeing 737-600. Substantial damage. No injuries.

The flight crew was taxiing the 737 to Stand 19 at London Gatwick Airport after an uneventful flight from Algeria the afternoon of May 31, 2006. As the aircraft neared the stand, the commander saw that the azimuth guidance for nose-in stands (AGNIS) visual docking-guidance system was illuminated, but he told the copilot that he could not see any stopping guidance, the U.K. Air Accidents Investigation Branch (AAIB) report said.

The commander saw a ground crewmember on the right side of the stand centerline and assumed that the crewmember was a marshaller. "He also noted a sign to the right of the AGNIS which he thought might be a stopping guidance signal, but this was in fact an extinguished emergency 'STOP' sign," the report said. "He elected to proceed. When he realized that no stopping guidance would be provided, either automatically or by the ground crewmember, he stopped the aircraft and, together with the copilot, completed the shutdown checks."

The report said that the commander had "misunderstood the information provided by the parking aids and overran [by 10.3 m (33.8 ft)] the correct stopping point while looking for a positive indication to stop." After the main cabin door was opened, the crew learned that the left engine cowling had struck the airbridge. "The gentle impact had not resulted in injuries, either to ground staff or aircraft occupants, and the passengers disembarked without further incident," the report said.

After the main cabin door was opened, the crew learned that the left engine cowling had struck the airbridge.

The ground crewmember that the commander had assumed was a marshaller was responsible for chocking the aircraft's wheels and connecting the ground power unit. The crewmember told investigators that he had observed that the aircraft had "gone a bit far" but did not consider it his responsibility to signal

Another ground crewmember attempted to illuminate the emergency "STOP" signal but could not find the activation button.

the pilots or to activate the emergency "STOP" signal. Another ground crewmember, who had lowered the airbridge, attempted to illuminate the emergency "STOP" signal but could not find the activation button.

The report said that the AGNIS system, which provides centerline-alignment guidance, and the parallax aircraft parking aid, which provides stopping guidance, were serviceable when the accident occurred but did not comply with International Civil Aviation Organization (ICAO) standards for advanced visual guidance systems (*ASW*, 5/07, p. 42). Among the ICAO standards is that docking guidance systems be visible to both pilots; the systems at Gatwick's Stand 19 were visible only to the left-seat pilot.

Control Lost During Aileron Roll

Learjet 35A. Substantial damage. No injuries.

The captain lost control of the airplane when he attempted an aileron roll during a cargo flight from Jacksonville, Florida, U.S., to Columbus, Ohio, the night of Jan. 10, 2007. The captain told investigators that the "intentional roll maneuver got out of control" during descent through Flight Level (FL) 200 (about 20,000 ft), the NTSB report said.

"The captain reported that the airplane 'oversped' and experienced excessive g-loads during the subsequent recovery," the report said. "The copilot reported that the roll maneuver initiated by the captain resulted in a 'nose-down unusual attitude' and a high-speed dive. Inspection of the airplane showed substantial damage to the left wing and elevator assembly."

Pressurization Indications Confuse Crew

Airbus A320-200. No damage. No injuries.

The aircraft was en route at FL 380 with 156 passengers from Kos, Greece, to Glasgow, Scotland, the night of Oct. 8, 2006, when the flight crew saw an excessive-cabin-altitude warning on the electronic centralized aircraft monitor (ECAM), indicating that cabin altitude had increased above 9,500 ft.

"However, the [ECAM] display showed the pressurization parameters, including the cabin altitude, as normal, so the crew believed that the warning was spurious," the AAIB report said. Nevertheless, the crew donned their oxygen masks and conducted the procedures specified in the flight crew operating manual (FCOM) for the cabin-altitude warning.

The no. 1 cabin pressurization system was in use, and investigators determined that the cabin pressure controller (CPC) for that system had malfunctioned and that the normal indications displayed for that system, including a cabin altitude of 7,800 ft, were erroneous. As a result, automatic selection of the properly functioning no. 2 system did not occur.

While conducting the FCOM procedures, the commander manually selected the no. 2 system and observed a cabin altitude indication of 10,400 ft on the ECAM display. Suspecting that the no. 2 system was malfunctioning, the commander reselected the no. 1 system.

"The cabin crew then reported that the cabin lights had illuminated full bright and that the seat belt signs had come on," the report said, explaining that this happens automatically when cabin altitude approaches 13,500 to 14,000 ft and before the passenger oxygen masks are automatically deployed.

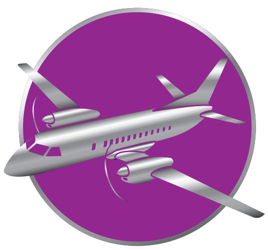
"After a few minutes, the commander reselected system 2 and [saw] a cabin altitude of 14,000 ft," the report said. "He reselected system 1, now believing that there was definitely a fault in system 2. The cabin crew then called to say that the passenger oxygen masks had deployed."

The copilot told the pilot that he had sensed a pressure change in his ears. The report said that neither pilot previously had experienced physical symptoms of increasing cabin altitude and that this might have confirmed their belief that the no. 1 pressurization system was functioning normally and that the no. 2 pressurization system was malfunctioning.

The flight crew declared an emergency and conducted an emergency descent to FL 100. During the descent, the crew observed a warning that the no. 1 pressurization system had failed, and they reselected the no. 2 system. "The flight continued to Glasgow at FL 100 without further incident, landing some 50 minutes later," the report said.

The report, which was issued in July 2007, said that the no. 1 system CPC was sent to Airbus for examination. The manufacturer confirmed that the CPC was faulty and that the information provided to the crew was confusing. Airbus told the AAIB, "This subject will be therefore further investigated … to review possible improvement in the current architecture."

TURBOPROPS



Crew Not Warned About Severe Turbulence

Bombardier Dash 8-100. No damage. One serious injury.

Daytime visual meteorological conditions (VMC) prevailed for the positioning flight from Honolulu to Kahului, Maui, Hawaii, U.S., on Jan. 31, 2007. In addition to the pilots, a deadheading flight crew and flight attendant were aboard the airplane.

The Dash 8 was about 15 nm (28 km) west of Maui, at an altitude not specified in the NTSB report, when the captain noticed that the indicated airspeed appeared to be lower than normal for the selected power setting and that the flap indicator showed a slight extension of the flaps. He asked the deadheading captain to look out a cabin window and observe the physical position of the flaps. The deadheading captain told the flying captain that the flaps appeared to be fully retracted. About this time, the Maui approach controller told the crew to descend to 1,500 ft.

The deadheading captain was returning to his seat when the Dash 8 encountered severe turbulence for 5 to 10 seconds. "He was thrown about the cabin and injured," the report said. None of the other five occupants was hurt.

The flight crew declared an emergency and received priority handling from ATC. After landing, the injured captain was transported by ambulance to a hospital, where a medical examination revealed that he had sustained a compression fracture of a lumbar vertebra.

The report said that soon before the Dash 8's turbulence encounter, the pilots of a Beech King Air and a Cessna 208 had reported moderate turbulence at 4,000 ft and moderate to occasional severe turbulence between 2,000 and 2,500 ft in the area. The approach controller relayed the pilot reports to a local flight service station but did not advise the Dash 8 crew of the reports.

Crane Operator Mistaken for Marshaller

Gulfstream Commander 690C. Substantial damage. No injuries.

After landing at Fairoaks Airport in Surrey, England, on Jan. 23, 2007, the pilot began taxiing toward the apron, where construction was in progress. "As he approached the apron, the pilot noticed a large crane to his left and some ground obstruction cones to his right," the AAIB report said. "He reported that he stopped the aircraft before reaching the crane and was then aware of someone in a yellow jacket, whom he presumed was a marshaller, appearing ahead of him."

The pilot continued taxiing while watching for adequate clearance from the crane on the left and also watching the "marshaller," assuming that he would ensure that the Commander was clear of the warning cones on the right. The pilot then heard a noise and shut down both engines. He found that the right propeller had struck a cone and a concrete block.

"Discussion with the 'marshaller' revealed that he was working with the crane and had come out purely because he was worried that the aircraft was going to contact the crane," the report said.

Vane Failure Precipitates Power Loss

Cessna 208B Caravan. Substantial damage. One minor injury.

The airplane was on initial climb from Globe, Arizona, U.S., for a cargo flight the morning of July 22, 2005, when the pilot heard a loud "thunk" and noticed a total loss of power. He began to turn back toward the airport but realized that he would not be able to reach the runway.

"The pilot initially set up to land on a highway but believed there was too much traffic and he would hit something," the NTSB report said. "He then focused on landing in a field adjacent to the highway." The Caravan touched down on the edge of the highway, rolled down an incline and came to a stop in the field.

Examination of the Pratt & Whitney Canada PT6A-114A engine revealed a fatigue failure of the outer rim of the compressor turbine stator vane. A fragment of the rim separated and damaged the downstream turbine blades. The engine had accumulated 4,461 hours of operation. The operator had received approval to extend the engine-overhaul period from 3,600 to 5,100 hours.

The report said that the operator had failed to conduct borescope inspections of the compressor turbine vane during fuel nozzle checks, as recommended by the maintenance manual and by Service Information Letter PT6A-116, issued in January 2003.

PISTON AIRPLANES

Disorientation During Night Takeoff

Piper Aztec. Destroyed. Four fatalities.

The pilot purchased the airplane in the United States on Dec. 23, 2005, and flew it to Providenciales Airport in the Turks and Caicos Islands, a British territory. On Dec. 26, a friend asked the pilot to fly him and four other people from South Caicos to Providenciales. "The pilot agreed to do so," the AAIB report said. "A payment of US$300 was reportedly arranged for the flight."

Nighttime VMC prevailed for the flight to South Caicos, to pick up the passengers. The pilot had 300 flight hours, including seven flight hours in the Aztec, and held a U.S. commercial pilot certificate. The report noted that he did not meet recency-of-experience requirements for flying at night with passengers.

After boarding the five passengers, the pilot was not able to start one of the engines. "After a while, the aircraft battery was drained, and the engine would no longer turn over," the report said. The pilot called a relative who lived on the island and asked him to bring a battery booster to the airport.

Two passengers decided not to fly. After boarding the three remaining passengers, the pilot was able to start both engines with the help of the battery booster. "The takeoff run was described as short, and the aircraft turned to the left very soon after it was off the ground," the report said. "The aircraft was seen to climb in the turn at first, then [enter] a steep descent." The Aztec struck the water at high speed about 2340 local time.

"Detailed examination found evidence of a substantial number of pre-impact powerplant anomalies but no signs of pre-impact failure or malfunction of the aircraft or its equipment relevant to the accident," the report said.

AAIB said that the accident investigation identified the following causal factors: "A lack of appreciation by the pilot of the difficulty of executing a turn, very shortly after takeoff, in conditions of almost complete darkness; [and] a loss of control of the aircraft as a result of spatial disorientation."

Main Gear Strikes Fence During Go-Around

Beech 58P Baron. Destroyed. Three fatalities.

The airplane was on a business flight from Corpus Christi, Texas, U.S., to Jeanerette, Louisiana, the afternoon of July 18, 2006. The Baron was about 15 nm (28 km) from the airport when the approach controller cleared the pilot for a visual approach and advised him of "light-to-moderate and possibly heavy precipitation" south of the airport.

The pilot said that he had the weather in sight, canceled his instrument flight rules flight plan and selected the airport advisory radio frequency. The destination airport was uncontrolled and had no instrument approach procedure.

The NTSB report said that there was a thunderstorm near the airport, and visibility was 1 mi (1,600 m) in heavy rain when the Baron touched down about halfway down the 3,000-ft (914-m) runway. Witnesses heard an increase in engine power and saw the airplane become airborne near the end of the runway.

The landing gear struck the airport perimeter fence, and the airplane struck a building, a utility pole, several trees, the roof of a house, several power lines and a mobile home. Both occupants were killed on impact; a person inside the mobile home was killed in the post-impact fire.

NTSB said that the probable causes of the accident were "the pilot's continued flight into adverse weather conditions and his delayed attempt to abort the landing." The 58-year-old pilot held an airline transport pilot certificate and had about 18,300 flight hours; his medical certificate had been revoked in 2002 for reasons not specified by the report.

Fuel Exhaustion Leads to Ditching

Cessna T303 Crusader. Destroyed. One serious injury.

The aircraft was at FL 100, about 30 nm (56 km) from the English coast, during a cargo flight from Braunschweig, Germany, to Oxford on Sept. 19, 2006, when the right engine began to run rough. The pilot selected the fuel boost pump; the right engine recovered briefly, then lost power. "On checking the fuel gauges, the pilot observed that they were indicating in the 'red sector,'" the AAIB report said.

The left engine lost power soon thereafter, when the aircraft was about 160 nm (296 km) from the destination. The pilot declared an emergency and ditched the aircraft near a ship about 9.5 nm (17.6 km) southeast of Aldeburgh.

"The aircraft survived the impact without breaking up, and when it came to rest, the pilot unstrapped, abandoned the aircraft through the emergency hatch, climbed onto the right wing, took off his shoes and got into the water," the report said. The aircraft sank about three minutes later.

There was no life raft aboard the Cessna, and the pilot had forgotten that two life vests were stowed in the rear of the cabin. Water temperature was 17 degrees C (63 degrees F). Personnel aboard the ship launched a life boat, but a Royal Air Force search-and-rescue helicopter reached the pilot first. He had been in the water for 18 minutes and was suffering from hypothermia when he was winched aboard the helicopter. After being transported to a hospital, he was diagnosed as having suffered a fractured vertebra.

AAIB said, "The investigation determined that the aircraft had run out of fuel, due to insufficient fuel for the intended journey being on-board the aircraft at the start of the flight." Investigators calculated that 545 lb (247 kg) of fuel were required for the flight and that there were 353 lb (160 kg) of fuel aboard the airplane when the flight began.

HELICOPTERS

Loose Cowling Severs Tail Rotor Shaft

Sikorsky S-76A. Substantial damage. No injuries.

The quick-release fasteners on the helicopter's drive shaft cowling had not been secured following recent maintenance on the tail rotor drive shaft. The NTSB report said that the pilot failed to notice the loose fasteners before conducting a charter flight on April 19, 2006.

The helicopter was flown from an offshore platform in the Gulf of Mexico to West Houston Airport and was air-taxied to the ramp. The pilot said that he made a right pedal turn to face the terminal building and was lowering the collective to land when the helicopter began to spin to the right.

The copilot said that the S-76 made three full turns before it struck the ground. The left main landing gear collapsed, and the four main rotor blades struck the ground. None of the 10 occupants was injured.

Examination of the helicopter revealed that the loose cowling had contacted and severed the tail rotor drive shaft. NTSB said that the probable cause of the accident was the failure of maintenance personnel to secure the cowling.

Stuck Check Valve Causes Fuel Starvation

McDonnell Douglas 600N. Substantial damage. No injuries.

The helicopter was cruising 500 ft above ground level during a business flight from Granada, Mississippi, U.S., to Vicksburg on Feb. 6, 2007, when the engine lost power without warning.

The pilot conducted an autorotative landing on a logging road. The tail boom and main rotor blades were damaged in the hard landing. The two occupants were not injured.

The NTSB report said investigators found that a fuel transfer check valve in the aft section of the fuel tank was stuck closed, causing the engine to be starved of fuel. ●

Preliminary Reports

Date	Location	Aircraft Type	Aircraft Damage	Injuries
July 3, 2007	Carlsbad, California, U.S.	Beech E90 King Air	destroyed	2 fatal, 1 minor
Visibility was 1/4 mi (400 m) when the airplane struck power lines on takeoff and crashed on a golf course, killing the two occupants. One person on the ground was injured by debris.				
July 5, 2007	Inverin, Ireland	Cessna 208B Caravan	destroyed	2 fatal, 4 serious, 3 minor
Instrument meteorological conditions (IMC) prevailed when the airplane struck terrain on approach to Connemara Airport during a demonstration flight.				
July 5, 2007	Culiacán, Mexico	Rockwell CT-39A Sabreliner	destroyed	9 fatal
The pilot lost control of the airplane after the tire on the right main landing gear exploded during takeoff for a cargo flight. The Sabreliner overran the runway and struck several motor vehicles. All three occupants and six people on the ground were killed.				
July 7, 2007	New York	Eurocopter France EC 130B4	substantial	8 none
The helicopter was on approach to the West 30th Street Heliport during a sightseeing flight when the pilot heard a loud bang and felt a vibration. Main rotor speed decreased, and the pilot deployed the floats and conducted an autorotative landing on the Hudson River. The occupants, who were wearing life vests, were rescued by boaters.				
July 8, 2007	Muncho Lake, Canada	de Havilland Canada Twin Otter	destroyed	1 fatal, 4 NA
The airplane crashed soon after takeoff from a gravel airstrip. One passenger was killed.				
July 10, 2007	Sanford, Florida, U.S.	Cessna 310R	destroyed	5 fatal, 4 serious
The airplane had leveled at 6,000 ft after departing from Daytona Beach when the pilot declared an emergency because of smoke in the cockpit. The Cessna struck trees and two houses during an attempted emergency landing at the Sanford airport. The two occupants of the airplane and three people on the ground were killed; four people on the ground were seriously injured.				
July 11, 2007	Fort Lauderdale, Florida, U.S.	Airbus A320, Boeing 757	none	172 none
Daytime visual meteorological conditions prevailed when the A320 was taxied onto the active runway while the 757 was touching down on that runway. The airport tower controller told the 757 crew to go around. The 757 passed less than 100 ft over the A320.				
July 17, 2007	São Paulo, Brazil	Airbus A320-200	destroyed	186 fatal, 30 serious
Heavy rain was falling when the airplane overran the 6,365-ft (1,940-m) runway, crossed a highway and struck a gas station and a cargo depot. All 168 occupants and 18 people on the ground were killed; about 30 people on the ground were seriously injured.				
July 17, 2007	Santa Marta, Colombia	Embraer ERJ-190	substantial	59 NA
The airplane veered off the left side of the runway while landing and came to a stop on an embankment, with its nose in the Caribbean Sea. None of the occupants was killed or seriously injured.				
July 19, 2007	Longmont, Colorado, U.S.	Beech C-45H	destroyed	1 serious, 1 minor
Both engines lost power during an instructional flight. The airplane struck a tree and a power pole, and crashed in a field.				
July 23, 2007	Dire Dawa, Ethiopia	Antonov An-26	destroyed	1 fatal, 8 NA
After departing for a cargo flight, the airplane was climbing through 3,500 ft when the left engine failed. One passenger was killed during the forced landing.				
July 24, 2007	Ketchikan, Alaska, U.S.	de Havilland Canada DHC-2	destroyed	5 fatal
IMC was reported in the area when the float-equipped Beaver crashed in mountainous terrain at about 2,300 ft during an air-tour flight.				
July 29, 2007	Moscow	Antonov An-12BP	destroyed	7 fatal
Visibility was 100 m (328 ft) in fog when the Antonov crashed in a forest soon after taking off from Domodedovo Airport for a cargo flight.				
July 31, 2007	Puerto Concordia, Colombia	Douglas DC-3C	substantial	10 NA
The flight crew conducted an emergency landing in a rice field after one engine failed. None of the occupants was killed.				

NA = not available

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

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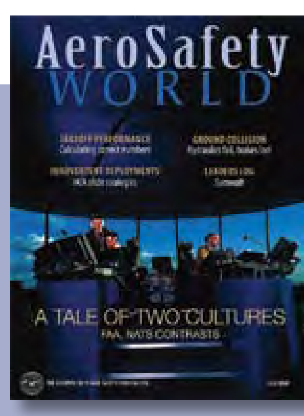

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SHARING GLOBAL SAFETY KNOWLEDGE

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