AeroSafety WORLD

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THE JOURNAL OF FLIGHT SAFETY FOUNDATION

APRIL 2010

FORGOTTEN Lesson

When something as painful as the volcanic ash shutdown of Europe occurs, there must be safety lessons to be learned. Let me try to point out one.

In the opening hours of the event, I was able to talk to some of the people in the Volcanic Airways Warning System, calling to offer congratulations. They have been tying together this diverse network for decades, and when a major eruption occurred in the middle of the North Atlantic Tracks, the system worked. But even in those early hours, there was a sense of impending doom. Those scientists and meteorologists all knew that vital information was missing. During years of meetings they had pressed to establish an ash concentration level that could be used as a safe operational threshold. But despite the presence of the smartest people on the subject, no one was allowed to offer a number. Their companies or their governments just didn't want to accept the potential liability.

As a result, things played out as you would expect. The scientists published charts showing where volcanic ash would be; they knew that it wasn't the information that was needed, but it was the best they were allowed to offer. This forced a bunch of regulators and politicians in Europe to make safety decisions in public that the experts were not even allowed to make in private. You can criticize the European authorities for over-reacting, but that is about as productive as critiquing the next sunrise. There isn't much you can do about it. Europe responded the only way it could. Maybe the authorities will do better next time, but only if they are not put in an impossible position.

Some have suggested that United States dealt with the problem more effectively during Alaskan eruptions. I am not sure that's the case. The U.S. solution was to delegate the decision to industry, a politically correct thing in that part of the world. Of course, industry leaders didn't have any better information than the European politicians, so they, in their turn, also did the normal thing: They dumped the problem on the captains. Pilots knew roughly where the ash was but had no information about how close they could operate. They just knew that too close could cause an accident, too far could bring their judgment into question, and if they smelled sulfur, they should probably turn. Not exactly a world-class risk-management process. However, a thousand uninformed decisions made in private create less of an uproar than a few big uninformed decisions made in public.

So what is the answer? It is pretty simple. Put the experts back in the room and keep the attorneys and the politicians out. Force a decision about the safe threshold, even if there is less information than we would like. If the data are shaky, make the best estimate and add a couple of zeros to it as a buffer. That process may sound crude, but that is how our predecessors did it. They knew that it was impossible to reduce political and civil liabilities by refusing to make decisions about risk. On this matter, we forgot that lesson, and look where it got us.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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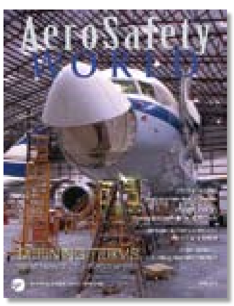

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the maintenance shop.
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MISDIRECTED Training

We got a letter this month (see p. 8) pointing out an error in our story on the February 2009 Colgan Air Bombardier Q400 accident near Buffalo, New York, U.S. (*ASW*, 3/10, p. 20). While we are not happy to have made an error, we are gratified that people read our stories so closely and take the time to provide feedback to correct the record.

But the writer went on to talk about an information video produced by the U.S. National Aeronautics and Space Administration (NASA) on tailplane icing, how it happens, how to recognize it and how to respond if it does cause a tailplane stall. He said that the Colgan pilots' actions perhaps were not just plain wrong, but were a result of having seen the video and selecting the wrong procedures.

I found the video on YouTube and watched a very well-produced educational piece of nearly 30 minutes that goes into great detail on how tailplane icing can develop, and how lowering flaps can alter the airflow around the iced tailplane and cause the controls to buffet and the tailplane to stall, pitching the nose down with force.

The recommended response to a tailplane stall is, the video said, pulling back strongly on the yoke, reducing flaps and adding no additional power. The Colgan captain did add some power, but he and the first officer did the other two steps perfectly. We all now know that was perfectly wrong, since the control buffet was actually a stick shaker and the nose-down force was a stick pusher and the event they failed to deal with correctly was not tailplane icing but a low airspeed warning.

It is believed that both pilots watched this video multiple times while with Colgan. They watched NASA test pilots flying a deHavilland DHC-6 with simulated ice shapes on the tailplane as the DHC-6 suffered a tailplane stall and recovered. Since they were flying an aircraft from that same lineage, there might have been a strong tendency to believe this video applied to the Bombardier (de Havilland DHC-8) Q400. And then they saw ice building up and talked about the ice, more than they had seen in a long time — unfamiliar territory — identifying icing as a potential threat. Whatever the mindset, when the low-speed warnings began, both pilots did exactly the opposite of what we are all taught over and over from the beginning of learning how to fly.

However, maybe they did not know that the Q400 is not subject to tailplane icing, one of the things the U.S. National Transportation Safety Board knew as it cited, among the several factors contributing to the crash, the pilots' failure to correctly monitor aircraft performance.

But returning to the video, how many airplanes in the United States or the world commercial fleet are subject to tailplane stalls? I can't say for sure, but my suspicion is that there are very few in airline service. Smaller aircraft, especially those with unpowered controls, run the risk of tailplane stalls, but this was not given sufficient attention in the NASA video, and I think that is a problem.

The video is not bad information, but it fails to clearly identify the context within which the information it presents should be viewed. It presents the information in a forceful "do this" manner without a discussion of other considerations.

I think this discussion should be added. Further, what purpose is served showing the video to pilots flying aircraft that cannot fall victim to tailplane stalls?

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

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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 1,040 individuals and member organizations in 128 countries.

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APRIL 19–23 ➤ 1st Pan American Aviation Safety Summit. International Civil Aviation Organization Regional Aviation Safety Group–Pan America and the Latin American and Caribbean Air Transport Association. São Paulo, Brazil. <panamericansafety@alta.aero>, <www.alta.aero/safety/2010/home.php>.

APRIL 20–21 ➤ Risk Management Course. ScandiAvia. Stockholm. Morten Kjellesvig, <morten@scandiavia.net>, <www.scandiavia.net>, +47 91 18 41 82.

APRIL 21–22 ➤ Search and Rescue 2010. Shephard Group. Aberdeen, Scotland. Hamish Betteridge, <hab@shephard.co.uk>, <www.shephard.co.uk/events/44/search-and-rescue-2010>, +44 (0)1753 727015.

APRIL 21–23 ➤ International Accident Investigation Forum. Air Accident Investigation Bureau of Singapore. Singapore. David Lim, <mot_iai_forum@mot.gov.sg>, <www.saa.com.sg/saa/en/News_And_Events/Events/saa_events_article_0031.html?__locale=en>.

APRIL 25–27 ➤ Asia Pacific ANSP Conference. Civil Air Navigation Services Organisation. Hua Hin, Thailand. Marc-Peter Pijper, <marcpeter.pijper@canso.org>, <www.canso.org/asiapacificconference>, +31 23 568 5386.

APRIL 27–29 ➤ World Aviation Training Conference and Tradeshow (WATS) and International Aircraft Cabin Safety Symposium. Halldale Media and *CAT Magazine.* Orlando, Florida, U.S. <www.halldale.com/wats>.

APRIL 28 ➤ Aviation Safety Management Systems Overview Course and Workshop. ATC Vantage. Tampa, Florida, U.S. <registrations@atcvantage.com>, <www.atcvantage.com/sms-workshop-April.html>, +1 727.410.4759.

APRIL 28–29 ➤ Fatigue Risk Management 2010: Reducing the Costs, Risks and Liabilities of Human Error in Today's Workforce. Circadian. Houston. Janet Reardon, <seminars@circadian.com>, <www.circadian.com/pages/396_houston_seminar_information_april_28_29_2010.cfm>, +1 781.439.6388.

APRIL 29–30 ➤ Regional Air Safety Seminar: Air Accident Investigation in the European Environment. European Society of Air Safety Investigators and Bureau d'Enquêtes et d'Analyses. Toulouse, France. Anne Evans, <aevans@aaib.gov.uk>, <www.isasi.org/docs/ESASI_2010_seminar_announcement.pdf>, +44 1252 510300.

MAY 3–5 ➤ Human Factors Train-the-Trainer. The Aviation Consulting Group. Montreal, Quebec, Canada. Bob Baron, <tacg@sccoast.net>, <www.tacgworldwide.com/humanfactorstraining.htm >, 800.294.0872 (U.S. and Canada), +1 954.803.5807.

MAY 4–6 ➤ EBACE2010. European Business Aviation Convention and Exhibition. Geneva. Romain Martin, <rmartin@ebaa.org>, <www.ebace.aero/2010>, +32 2.766.0073 (Europe); Donna Raphael, <draphael@nbaa.org>, <www.ebace.aero/2010>, +1 202.478.7760.

MAY 4–6 ➤ Accident/Incident/Hazard Investigation Training. Prism Training Solutions. Denver. Kendra Christin, <www.aviationresearch.com>, +1 513.852.1010.

MAY 9–13 ➤ AsMA Annual Scientific Meeting. Aerospace Medical Association. Phoenix. Gloria Carter, <gcarter@asma.org>, <www.asma.org/meeting/index.php>, +1 703.739.2240, ext. 106.

MAY 10–12 ➤ Safety Management Systems in Aviation Course. AviAssist Foundation and Zambia Air Services Training Institute. Lusaka, Zambia. Tom Kok, <tom.kok@aviassist.org>, <www.aviassist.org>, +44 1326 340 308.

MAY 10–14 ➤ Aviation Lead Auditor Training. Argus Pros. Denver. John H. Darbo, <www.pros-aviationservices.com/alat_training.htm>, +1 513.852.1057.

MAY 10–14 ➤ Just Culture Certification Training. Outcome Engineering. Grapevine, Texas, U.S. <info@outcome-eng.com>, <outcome-eng.com/justculture.html>, +1 214.778.2038.

MAY 11–13 ➤ Corporate Aviation Safety Seminar. Flight Safety Foundation and National Business Aviation Association. Tucson, Arizona, U.S. Namratha Apparao, <apparao@flightsafety.org>, +1 703.739.6700, ext. 101.

MAY 12–13 ➤ Fatigue Risk Management 2010: Staffing, Scheduling and Training the 24/7 Workforce. Circadian. London. Janet Reardon, <seminars@circadian.com>, <www.circadian.com/pages/580_london_seminar_information_may_12_13_2010.cfm>, +1 781.439.6388.

MAY 13 ➤ Introduction to the Flight Safety Foundation Approach and Landing Accident Reduction Tool Kit. AviAssist Foundation and Zambia Air Services Training Institute. Lusaka, Zambia. Tom Kok, <tom.kok@aviassist.org>, <www.aviassist.org>, +44 1326 340 308.

MAY 14 ➤ Introduction to International Air Law. AviAssist Foundation and Zambia Air Services Training Institute. Lusaka, Zambia. Tom Kok, <tom.kok@aviassist.org>, <www.aviassist.org>, +44 1326 340 308.

MAY 17–21 ➤ Practical System Safety Course. Southern California Safety Institute. San Pedro, California, U.S. Sharon Morphew, <registrar@scsi-inc.com>, <www.scsi-inc.com/PSS.php>, +1 310.517.8844.

MAY 17–22 ➤ Human Factors in Flight Safety: Risk Management and Accident Investigation. European Association for Aviation Psychology and Nav Portugal. Lisbon, Portugal. <bhayward@dedale.net>, <www.eaap.net/courses>.

MAY 18–20 ➤ Advanced SMS Training. Prism Training Solutions. Denver. Kendra Christin, <www.aviationresearch.com>, +1 513.852.1010.

MAY 18–19 ➤ Safety Implications of Fatigue Risk Management Systems. Asociación Sindical de Pilotos Aviadores de México and International Civil Aviation Organization. Mexico City. Circe Gómez, <atecnicos@aspa.org.mx>, +52 (55) 5091-0559, ext. 1214.

MAY 24-26 ➤ Human Factors Train-the-Trainer. The Aviation Consulting Group. Calgary, Alberta, Canada. Bob Baron, <tacg@sccoast.net>, <www.tacgworldwide.com/humanfactorstraining.htm>, 800.294.0872 (U.S. and Canada), +1 954.803.5807.

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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 until 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.

Angle-of-attack versus airspeed

Congratulations on another great issue!

As I read the Causal Factors article on the Colgan Air accident (*ASW*, 3/10, p. 20), I became confused where it reads as follows:

"The crew set the V_{REF} 'bugs' on their airspeed indicators to 118 kt. This value was appropriate for an uncontaminated airplane. However, when the crew activated the deicing equipment during departure from Newark, they also set the 'REF SPEEDS' switch on the ice-protection panel to 'INCR' (increase). This action is required by the Q400 airplane flight manual before entering icing conditions and results in activation of the stick shaker at a lower angle-of-attack — thus, at a lower airspeed."

Whoa, pardner! I don't think the author should make a simple linear comparison between AOA and airspeed. There's another factor in there called "induced drag." If weight, bank angle and other factors are held constant, a slower airspeed demands a higher angle-of-attack to produce the same lift.

Conversely, if the stick shaker artificially fires at a lower AOA for a given wing design and its own unique lift and drag characteristics, we can generally assume it is occurring at a higher airspeed than V_S … can't we?

I think this is fundamental to the understanding of how these pilots were startled by the stick shaker at an airspeed some 13 kt above their "clean wing" and unmodified bug speeds.

I respectfully disagree with the NTSB, which downplayed the potentially negative effect of the FAA-approved training program's inclusion of the NASA research video "Tailplane Icing," which includes information on tailplane stall and recovery characteristics. The NTSB waltzed around it when they acknowledged that the Q400 is not subject to the phenomenon. I firmly believe this startled captain, experiencing stick shaker at a higher-than-expected airspeed, instinctively began to raise the nose and subsequently fought the stick pusher — which he probably attributed to the forward stick force demonstrated in the video.

Why else would the first officer raise the flaps, uncommanded by the captain, other than the fact that the FO in the video does this? Some theorize she wanted to return to the last stable configuration. But basic flying instruction warns against this on the back side of the power curve. At 100 kt, the only things keeping them in the air were the props.

Mont J. Smith
Director of Safety
Air Transport Association of America

The editor replies: *The reader is correct. Increasing the reference speeds for icing conditions would cause the stick shaker to activate at a lower angle-of-attack and, thus, at a* higher *airspeed. The NTSB report noted that the appropriate landing reference speed (V_{REF}) under the existing conditions was 138 kt. We have corrected the on-line edition of the magazine.*

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

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

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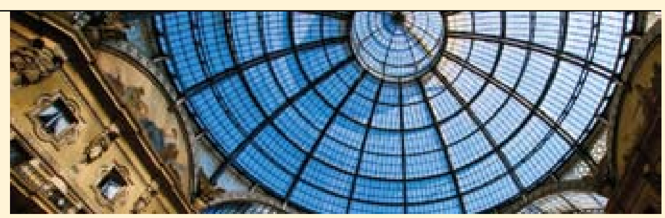

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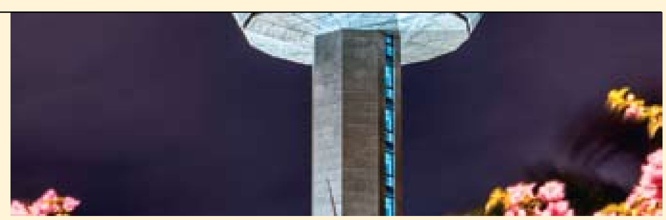

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Safety News

Dealing With Depression

U.S. pilots who take medication for depression may, under certain circumstances, be eligible for the special issuance of medical certificates from the U.S. Federal Aviation Administration (FAA).

The new policy, which took effect April 5, replaces a previous FAA position that prohibited pilots from flying if they took antidepressants.

"We need to change the culture and remove the stigma associated with depression," said FAA Administrator Randy Babbitt. "Pilots should be able to get the medical treatment they need so they can safely perform their duties."

Under the new policy, pilots who take one of four antidepressant medications — fluoxetine (Prozac), sertraline (Zoloft), citalopram (Celexa) or escitalopram (Lexapro) — will be permitted to fly "if they have been satisfactorily treated on the medication for at least 12 months." Other antidepressants eventually may be added to the list, the FAA said.

When a pilot requests treatment for depression, he or she will be grounded "until all symptoms of the psychiatric condition being treated are improved by the single medication and the pilot is stable for 12 months," the FAA said.

The FAA said it would give pilots six months to "share any previously non-disclosed diagnosis of depression or the use of these antidepressants" without taking civil enforcement action against them. If they have been treated successfully, they should be flying again in a few months, the FAA said.

The FAA's new stand conforms to recommendations from the International Civil Aviation Organization and the Aerospace Medical Association and resembles policies already put in place by the Civil Aviation Safety Authority of Australia, Transport Canada and the U.S. Army.

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Expanding Blacklist

All air carriers from Sudan and the Philippines have been added to the European Commission blacklist of airlines prohibited from operating within the European Union (EU).

The carriers were added in the 13th update of the list, adopted in late March, because of the International Civil Aviation Organization's (ICAO's) assessments of aviation safety oversight in those two countries.

"Safety comes first," said European Commission Vice President Siim Kallas, who is responsible for transport. "We are ready to support countries that need to build up technical and administrative capacity to guarantee the necessary standards in civil aviation, but we cannot accept that airlines fly into the EU if they do not fully comply with international safety standards."

Barcex/Wikimedia

The commission imposed restrictions on Iran Air's operations in the EU because of "evidence of serious incidents and accidents … and insufficient oversight from the authority over the past year."

Under the updated list, Air Koryo, licensed in North Korea, has been permitted to resume operations in the EU with two airplanes that are equipped with "the necessary equipment to comply with mandatory international standards and following appropriate oversight by its authority."

The commission said it recognized improvements within TAAG Angola Airlines and would permit the carrier to operate with specific airplanes and under specific conditions to all EU destinations. Previously, it was permitted to operate only to Lisbon.

The blacklist bans all carriers from 17 countries — a total of 278 carriers — from operating in the EU, along with three carriers from other countries whose operations are banned throughout the EU. In addition, 10 carriers are permitted to operate only under specific conditions.

Civil Penalties

The U.S. Federal Aviation Administration (FAA) has proposed a $1.45 million civil penalty against Northwest Airlines for allowing some of its Boeing 757s to be operated without proper inspections of windshield wiring. The agency also proposed smaller civil penalties against two other operators.

The FAA said that in the Northwest case, airline maintenance instructions written in 1990 did not mention the need for inspections of wires under the first officer's window, as discussed in an FAA airworthiness directive (AD) that required inspections to check for undersized wires in window heating systems. As a result, 32 airplanes were not in compliance with the AD when they were flown on more than 90,000 passenger flights between Dec. 1, 2005, and May 27, 2008.

On May 28, 2008, the airline discovered that the inspections had not been performed and revised its maintenance instructions to require that the work be performed at the next scheduled overnight layover. The FAA said the work should have been performed before any additional flights.

Wikimedia

"When an air carrier realizes that an [AD] is not being followed, the problem must be corrected immediately," FAA Administrator Randy Babbitt said. "Safety cannot wait for the next scheduled maintenance."

In a separate action, the FAA proposed a $380,000 penalty against Frontier Airlines for operating some of its Airbus A318s and A319s with outdated placards depicting how to operate emergency overwing exits. The FAA also proposed a $260,000 penalty against ERA Helicopters for returning one of its helicopters to service without the required test flights and other checks.

Each operator was given 30 days from its receipt of the civil penalty letter to respond to the FAA.

Blacklist Critique

The African Airlines Association (AFRAA) has criticized the European Commission's blacklist for doing little to help improve aviation safety in Africa.

"While the EU [European Union] list may be well-intended, its main achievement has been to undermine international confidence in the African airline industry," AFRAA Secretary General Nick Fadugba said. "The ultimate beneficiaries of the ban are European airlines which dominate the African skies."

If the international aviation community believes a list is necessary, it should be published by the International Civil Aviation Organization, which has a "known track record of impartiality," he said.

Of the 17 countries with airlines affected by the ban on operations within the EU, 13 — with a total of 111 airlines — are in Africa. Many of those airlines are not operational, or have never operated scheduled flights to Europe, have no plans to do so and "have no aircraft with the range to fly to any EU state," the AFRAA said.

© Reuters/Olafur Eggertsson

A plume of volcanic ash fills the skies near Iceland's Eyjafjallajokull Volcano. The ash cloud grounded aircraft for days and prompted efforts to define safe levels of operation during future volcanic eruptions.

Controller Hiring Faulted

The U.S. Federal Aviation Administration (FAA) does not effectively screen or train new air traffic controllers, assigning some to the nation's busiest air traffic control facilities before they are capable of handling the job, according to a report by the Department of Transportation Office of Inspector General.

"FAA's process for selecting and placing new controllers does not sufficiently evaluate candidates' aptitudes because FAA does not effectively use screening test results or consider candidates' [training academy] performance to help determine facility placement," the report said. "As a result, new controller candidates — many of [whom] have no prior air traffic control experience — are being assigned to some of the busiest air traffic control facilities with little consideration of whether they have the knowledge, skills and abilities necessary to become certified controllers at those locations."

Managers of the facilities have complained that some new controllers — who have passed training programs — arrive at their assigned air traffic control facilities unprepared for additional training designed specifically for employees of that particular facility, the report said, adding that this

U.S. Federal Aviation Administration

indicates the FAA must restructure its testing and training procedures.

The report recommended re-evaluation and redesign of the screening test "to consider candidates' skill sets, assign candidates to a facility based on their [training academy] performance and improve its … training program" by implementing recommendations developed in 2007 by an FAA training and development group. The FAA agreed in part with the report's findings and proposed corrective actions for all recommendations, the report said.

© Piotrek Bozyk

Polish President Lech Kaczynski and 95 others were killed when his presidential jet — this Tupolev 154M — crashed in dense fog during an approach to Smolensk Air Base in western Russia on April 10. Russian press reports said that the airplane descended below the glideslope while on final approach and struck the ground.

In Other News …

In response to the transformation of light aircraft cockpits from conventional flight instruments to integrated computerized **glass cockpits**, the U.S. National Transportation Safety Board is recommending changes in pilot training to improve pilot understanding of the advanced technology. … The Civil Aviation Safety Authority of Australia has begun a review of pilot proficiency records aimed at evaluating the effectiveness of the **flight crew training** and checking system. The project is expected to be completed late in 2011. … A four-hour outage on Nov. 19, 2009, of the U.S. Federal Aviation Administration's **telecommunications infrastructure** was caused by "errors in network maintenance and monitoring during a telecommunications upgrade," an independent review panel says.

Compiled and edited by Linda Werfelman.

There's more to it than just maintenance.

BY NEIL RICHARDSON

The challenges faced by today's aviation industry are plenty; many relate to the performance of human beings in complex systems. Appropriate behavior of personnel is key to contributing to systemic safety, but this requires a clear understanding not only of human factors but also of the basic concepts of, and relationships between, airworthiness and maintenance. In a world where noncompliance with rules and standards is still a major issue, how many of these unsafe acts can be attributed to insufficient knowledge of how the system was designed to operate?

Defining 'Airworthiness'

Is there a gap between the maintenance program and the maintenance organization's output — that is, between airworthiness and maintenance? The foundations upon which the concepts of airworthiness are built seem to have been weakened — or to never have been fully established — and there may be a need for the industry to go back to the basics to understand the two concepts.

Problems resulting from misunderstanding the relationships within the approval system vary, but they are numerous, and they exist at all levels within organizations, from the continuing airworthiness organization — for commercial air transport, this is the role of the operator — not supplying the maintenance organization with correct information, to the technical records staff seeing their role as "just a clerk," to the maintenance technician believing that the data limits are only a guide and that a deviation can be justified based upon his or her experience. Such mindsets can result from insufficient awareness of how the system is designed to operate.

National regulations provide clear lines of responsibility for those organizations involved in managing continuing airworthiness and those involved in maintenance, yet the relationship between these requirements often is lost in translation. The operator's continuing airworthiness management organization is responsible for ensuring that a contract is in place between such organizations, and this key document should play a pivotal role in how the maintenance activity is performed. It is common, however, for the contract to focus mainly on commercial — rather than technical — aspects, and in some cases, loss of a contract is used as a bargaining tool or threat, rather than for setting out how each party will contribute to the overall objective of ensuring airworthiness.

Without the correct focus on the basic understanding of the system as a whole, myths and unfounded beliefs will prevail, exacerbated by inappropriate operator behaviors that are not in line with the contract or regulation.

What Is 'Airworthiness'?

The terms "airworthy" and "airworthiness" are used throughout global and national standards; however, none of these standards defines "airworthiness." For this paper, we shall assume the following, developed from a U.K. Ministry of Defence definition:

> *Airworthiness is the ability of an aircraft or other airborne equipment or system to operate without significant hazard to flight and cabin crew, ground crew, passengers, cargo or mail (where relevant) or to the general public and property over which such airborne systems are flown.*

As illustrated, many activities contribute to airworthiness, and the term encompasses more than just maintenance. Certain elements of airworthiness are either accomplished directly or influenced by the performance of maintenance, but in some cases, they lack a connection to the overall airworthiness management system.

The responsibility for ensuring that these elements are accomplished lies with the organization managing airworthiness. Maintenance activities that contribute to airworthiness must be performed by approved maintenance organizations. It must therefore be clear and unambiguous what is required of those organizations — something provided for by the contract.

What Is 'Maintenance'?

This sounds like a simple question, but the objectives of maintenance are varied. For example, scheduled maintenance serves to:

- Confirm the inherent safety and reliability levels of the aircraft (as determined by design);
- Restore safety and reliability to their inherent levels should deterioration occur;
- Obtain information required for redesign in light of discovered system inadequacies; and,
- Accomplish all of this at minimum cost.

The link between the two functions is the maintenance program — a continuing airworthiness requirement, which should reflect the needs of the operator's aircraft, driven by data collected via the reliability program. The maintenance organization performs the required maintenance tasks as determined by the program and contracted by the operator.

That is the concept of the system in a nutshell. Maintenance personnel often believe, however, that they are solely responsible for the airworthiness of the aircraft. This is often reinforced and perpetuated by technical representatives who manage the interface between the operator and the maintenance organization; many of these representatives have a background in maintenance rather than in airworthiness.

Personal Judgments

Experience has shown that many maintenance personnel still believe that it is appropriate to make a judgment — for example, to decide, based on previous experience, not to replace a component

The world of perceived or real commercial pressure can lead to well-intentioned yet potentially unsafe acts.

that is barely out of limits, or, conversely, to replace an item close to limits even though it has had zero degradation since it was last inspected.

The first example may be seen by some as a case of qualified, experienced staff making a judgment based on their maintenance experience, which is what they are paid to do. The second example may raise eyebrows; best practice would, of course, dictate that it be brought to the operator's attention to review the records and decide on a course of action. Given the principles of airworthiness, however, it would be difficult for an inspector within a maintenance organization — who at the time of inspection sees only a snapshot and not the full airworthiness picture — to make an accurate judgment about whether an item would remain serviceable until the next planned inspection. Such a judgment would require knowledge of the specific degradation rate and the failure modes and effects of the item. Having the next due date written on the work card would not be sufficient information from which a judgment could be made. Data such as utilization, operational profile, environmental considerations and wear rates would need to be considered, and this is something that can only be achieved by the organization managing airworthiness. Such data are fed into the maintenance program, and whether an item will remain serviceable until the next check will be determined by the maintenance program.

The inspector's contribution is to inspect at a known interval and to a pre-determined inspection standard, and to compare findings with the

© Chris Sorensen Photography

Excessive wear of a jackscrew was blamed for the crash of an Alaska Airlines MD-83 in 2000.

Photos: U.S. National Transportation Safety Board

The lower end of the MD-83's jackscrew assembly was threaded through an acme nut, which was attached to the vertical stabilizer with this gimbal ring.

limits defined in applicable maintenance data, such as the aircraft maintenance manual. The inspection intensity (including the inspection aids that are used) and conditions (lighting, access and cleanliness) will effectively dictate the threshold for reportable defects. These criteria are carefully selected, based on the design criteria, the criticality of each item, and maintenance and operational economics. Inspection staff must not be permitted to deviate from such limits, unless authorized through a company procedure involving the operator.

The fatal Jan. 31, 2000, accident in which an Alaska Airlines McDonnell Douglas MD-83 crashed into the Pacific Ocean off the Southern California coast, killing all 88 passengers and crew, revealed many failings, including failure to consider degradation rates effectively. The U.S. National Transportation Safety Board (NTSB) determined that inadequate maintenance and insufficient lubrication led to excessive wear and catastrophic in-flight failure of the threads of the horizontal stabilizer trim system jackscrew assembly's acme nut.[1]

What was not considered at the time by the maintenance organization was the fact that historic maintenance on the affected item was substandard, and that, in conjunction with other failures (some the fault of the operator), the degradation rate was increasing. The outcome was catastrophic.

Insufficient Knowledge

The world of perceived or real commercial pressure can lead to well-intentioned yet potentially unsafe acts. Yet it remains unanswered how many of these acts are a result of insufficient basic knowledge of "the system." A recently overheard conversation in a restaurant between two maintenance technicians prompted a discussion that began to explore that question. To summarize the debate, one of the technicians was encouraging the other to consider becoming certifying staff.

"I would not know what to look for," said the less experienced technician. The response from his more experienced colleague was alarming: "You soon pick it up. You know what to look for and what you can get away with." The conversation continued, revealing more examples of instances in which maintenance staff made judgments based on personal experience but clearly well beyond the limits of the applicable maintenance data. In this case, rivets as specified by the drawing were not available, so the certifier decided, while eating dinner, that he would install "alternatives." This behavior begins to move the degradation curve away from what is expected, making future judgments potentially lethal.

Was this being unprofessional? Some would argue yes, but how many other technicians in the organization would have acted in the same manner? Did the maintenance organization fail the technician by not providing the right parts? It would appear from the conversation that this was the case. Would the customer have reacted inappropriately if the technician had behaved assertively and not agreed to certify the task? Recent experience indicates that this is not unheard of. To ask a rhetorical question, to what extent did the operator, the maintenance organization and/or the technician not understand the basic principles of airworthiness?

Many issues that are seen today could be linked to this gap in our knowledge. Further examples:

- Using the classic sign off "SATIS" (satisfactory), which means little to the continuing airworthiness management organization when trying to determine degradation rates — as opposed to recording measured dimensions, tolerances and so forth;
- Considering "greasing" to be a mundane task, rather than one that prevents a failure mode of a possibly critical safety item;
- Providing parts directly to the technician from the operator, bypassing the process — optimally performed by a maintenance organization or repair station — of checking a purchase order and inspecting the parts; and,
- Applying pressure on the maintenance staff to not "look too hard" or "snag" too much.

All of these "minor" transgressions ultimately lead to a change in the degradation rates or the economic basis of the maintenance program. Reliability, based upon analysis of data and maintenance findings, should detect trends, but if defects are being "let go," then the validity of the data is flawed, undermining the trends, and the effectiveness of the overall maintenance program. Quite simply, the system assumes — and is predicated upon — the maintenance organization fulfilling its responsibilities to the contract and to the standard. If the operator requires a different standard to be applied, this must be reflected in its maintenance program, thus putting the responsibility in the right place.

Bring into the equation the organizations that manage lease hand-backs on behalf of the operator, and the need to understand the basics becomes even more evident. A recent event over Clacton, England, involving a Boeing 737 on a post-maintenance check flight appears to highlight this need. During the hydraulic power-off test, which was required because the elevator tabs had been adjusted, the airplane entered an unexpected descent — at one point, the descent rate hit 21,000 fpm. While the final report on the event has yet to be issued, an interim report suggests that the interface between the operator and the maintenance organization, which appears to have been managed by a third party (the lease hand-back organization), could have been handled more effectively. Would a more comprehensive understanding of the principles of the system by personnel and organizations have influenced their behavior and therefore the outcome of the event?

Closing the Gap

Many options appear open to industry; for example, the aircraft maintenance license requirements could be enhanced to include an airworthiness module that explores the approval system, the concepts of airworthiness, the associated responsibilities and how these are achieved. Similarly, degree courses could include the same information. For existing members of industry, maintenance organizations and operators could include such a module in their induction training; certifying staff could receive continuation training or authorization issue/renewal training. Guidance material could be developed to highlight the fact that the technical representative fulfils a continuing airworthiness function and any maintenance bias must be tempered.

It would appear that there is plenty of room for maneuvering by the personnel and organizations involved to bridge the gap between airworthiness and maintenance.

Neil Richardson is a senior consultant with Baines Simmons, an airworthiness and aviation safety consulting and training firm. Richardson's areas of expertise include continuing airworthiness management and human factors in aircraft maintenance.

Note

1. NTSB. Accident report no. DCA-00MA023. Jan. 31, 2000. The accident report was the subject of the February 2003 issue of *Accident Prevention.*

A NEW APPROACH

ICAO will shift from periodic audits to a system based on continuous data-driven monitoring.

J.A. Donoghue

BY J.A. DONOGHUE | FROM MONTREAL

When member nations of the International Civil Aviation Organization (ICAO) agreed in 1997 to a system of audits of nations' safety oversight capabilities — the Universal Safety Oversight Audit Program (USOAP), a major component of the Global Aviation System Plan (GASP) — the aviation community took a big step forward in safety. Since then, however, both the benefits and drawbacks of the audits, lately conducted on a six-year cycle, have become clear.

One basic problem with the cycle approach, aside from being costly, is that it gave all nations an equal amount of attention in a single-shot rotation that had to last for six years. Clearly, some nations do not need such regular attention, while others need more attention, and more help, more frequently, than the audit cycle was geared to provide. The audits did show the benefits of examining what was going on in nations around the world, and provided the information through which ICAO staffers could see the statistical relationship between those nations that scored poorly on the audit results and the regions and nations with the worst safety record, validating the audit process. Most alarming to ICAO were the low-scoring, high-accident, high-growth nations.

After lengthy consultation and planning dating from mid-2008, which included input from many stakeholders in the process, a new concept was born — the Continuous Monitoring Approach (CMA), a concept that won the support of the ICAO Council.

In late March, ICAO hosted the High Level Safety Conference (HLSC), gathering representatives and heads of civil aviation regulatory bodies from as many as 150 nations, plus various industry participants such as Flight Safety Foundation and the International Federation of Air Line Pilots' Associations.

CMA was high on the HLSC agenda, as the ICAO staff sought widespread acceptance of the concept. And that, after some discussion, is what they got, setting CMA up to be adopted by the ICAO Assembly when it meets this October. If adopted, CMA will become the standard in January 2013.

While the transition to CMA from the existing Comprehensive Systems Approach (CSA) audit process was designed to be flexible, a number of nations at the conference were concerned that the proposed two-year transition period was too rushed, and that some smaller nations would be swamped. Some nations suggested that as many as six years would be required to make CMA the standard.

Henry Gourdji, chief of the Safety Oversight Audit Section, USOAP, told *AeroSafety World* that some of the discomfort with the two-year transition was caused by nations mixing the concurrent State Safety Program (SSP) effort with CMA.

"SSP is not directly linked to CMA," he said. "You don't need to have an SSP in place at the end of the CMA transition. SSP data will make CMA more efficient, but ICAO could launch CMA tomorrow" using data already existing in the system, Gourdji said.

However, in recognition of this perception of CMA being rushed into implementation, the HLSC recommended that regular reports be made to the ICAO Council on the progress that nations and ICAO make in implementing the transition plan. If the reports indicate problems, additional time may be provided to complete the transition of the USOAP to a CMA, ICAO documents say.

The goal of CMA is to not only spread out the monitoring process into a more even distribution of effort but also to allow ICAO to tailor its response and its ability to help nations meet specific needs without being held captive to the calendar.

"Before, our hands were tied," Gourdji said. "Just one full-blown audit every six years, and then the response to that audit. We could not go back for six years, even if we had the personnel to do so. Now we can customize the intervention to specific needs as they arise."

Previously, the ICAO audit was the same each time, the approximately 900 questions that are part of the CSA protocol. These 900 questions won't change, but now they will be combined to suit specific needs. Gourdji noted the four different types of ICAO interventions anticipated under the CMA regime:

- ICAO Coordinated Validation Missions

  To determine if previously identified safety deficiencies have been resolved by assessing the status of corrective actions or mitigating measures taken to address findings and recommendations.

- CSA Audits

  The full-scale CSA audits will not disappear but will be available to help ICAO to determine nations' ability to conduct effective safety oversight, tailored to the level of complexity of aviation activities in the nation concerned.

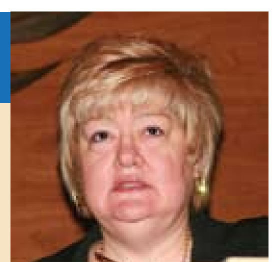
- Limited CSA Audits

  These will address specific areas, such as air navigation services, aerodromes, aircraft flight operations or airworthiness, useful in nations where oversight in some areas is less developed than others, or where a specific technical area has undergone a significant change.

- Safety Audits

  Safety Audits will respond to the request of the nation involved, principally when the head of safety for that nation seeks an independent evaluation, defined and paid for by the requesting nation.

Why the Change?



Graham

J.A. Donoghue

While the Global Aviation Safety Plan (GASP) has made some progress in reducing accidents, gaps remained that the current process was not closing, said Nancy Graham, director of the International Civil Aviation Organization Air Navigation Bureau. Detailing accident statistics cut several different ways, she gave this summary to the High Level Safety Conference:

"There have been mixed results with respect to the GASP safety targets. We have made progress in meeting the first target, as fatal accidents and the number of related fatalities have decreased over the past 10 years. We have not been as successful in achieving the second target, which requires a significant decrease in the global accident rate. Finally, it has become apparent that a change in strategy is needed to achieve the third GASP safety target. Not only is one region's accident rate more than double the global rate, but the variance between regional accident rates remains unacceptably high."

— JAD

Much of the CMA process will be conducted online through a secured site where all the stored data and information transfer will be handled for the participating nations and where the people who will administer the process in each nation will be trained. Through this site, nations will post their Corrective Action Plans addressing identified weaknesses.

Further, through this site, ICAO can transmit three key elements of the CMA process: Mandatory information requests triggered by data analysis, perhaps employing ICAO's new, recently commissioned Integrated Safety Trend Analysis and Reporting System (ISTARS); requests for agencies to clarify their situations; and ICAO findings and recommendations.

The entire CMA process is based on the availability of data, and while Gourdji and others in the organization maintain that the existing flow of data is already sufficient to start the process, a more structured and widely based data collection and distribution regime is being sought. This advance also was endorsed by the HLSC.

While ICAO already has access to much of the information gathered by carriers and regulatory bodies, during the HLSC a "declaration of intent" to exchange safety data was signed by ICAO, the International Air Transport Association, the U.S. Federal Aviation Administration and the Commission of the European Union, a move seen as the start of a trans-industry process of data exchange.

Nancy Graham, director of the Air Navigation Bureau, in speaking to the HLSC, noted the importance of information to feed the CMA effort: "Future development of safety analysis systems such as ISTARS depends on the availability of the multiple types of information having an impact on safety — including information provided through development of SSPs and safety management systems, information related to a state's aviation infrastructure, and economic information that may provide clues as to how to best manage anticipated growth."

The conference agenda also addressed the issue of securing the location and recovery of flight data recorders and cockpit voice recorders, brought into sharp focus by the June 1, 2009, crash of an Air France Airbus A330 in the South Atlantic in which the failure to recover the recorders has hindered investigators' ability to pinpoint the cause of the accident.

In a news release issued after the event, ICAO said, "The Conference recommended that ICAO look into technical enhancements that would improve the ability to locate and recover the units, such as longer time periods for signals, better resistance to crashes and floatability."

Roberto Kobeh González, president of the Council of ICAO, said in the release, "While the electronic transmission of information during flights is progressively improving, black boxes will remain absolutely indispensable for years to come as the primary source of technical data in cases of accidents or incidents."

The Conference also called on states and industry to ensure improved communication and surveillance of flights over oceanic and remote areas using all available technologies.

CMA Transition Steps

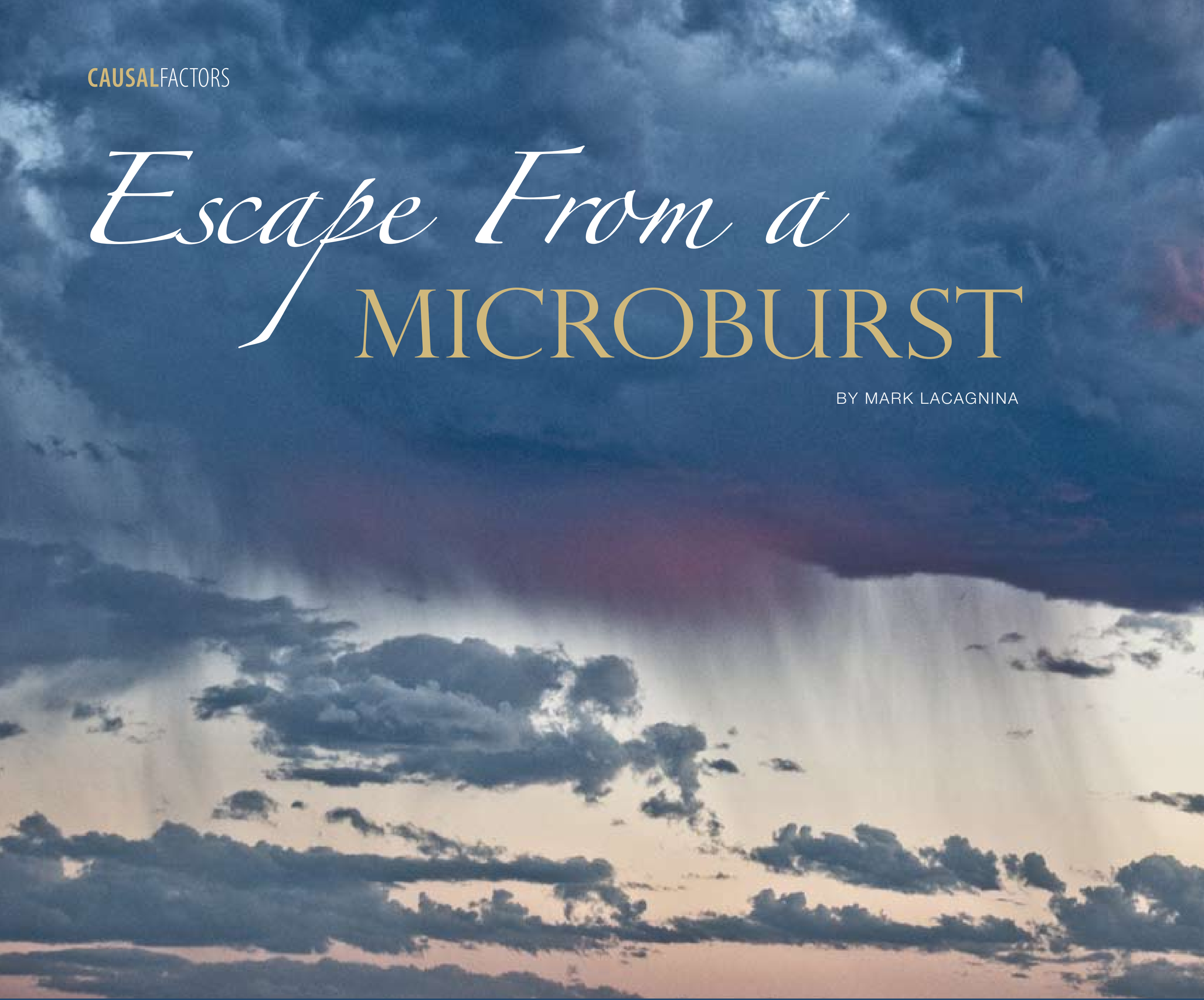
Member State Steps

- Sign new memorandum of understanding
- Assign national continuous monitoring coordinator (NCMC)
- NCMC completes computer-based training on Continuous Monitoring Approach (CMA)
- Update corrective action plan from the previous audit
- Develop a plan for the new CMA protocols and transmit it to the International Civil Aviation Organization (ICAO)
- Update online the state aviation activity questionnaire
- Complete online the Universal Safety Oversight Audit Program (USOAP) CMA protocols

ICAO Steps

- Publish new edition of Doc 9735, *Safety Oversight Audit Manual*
- Develop and expand agreements with international entities
- Test CMA online framework with some member states
- Conduct regional CMA workshops
- Launch computer-based training of auditors
- Conduct 10 ICAO coordinated validation missions in 2011, 20 in 2012
- Conduct safety audits at the request of member states

— JAD



Escape From a MICROBURST

BY MARK LACAGNINA

The PIC conducted a go-around after the 747 was slammed onto the runway.

The flight crew had the sensation of being pushed down and sideways as the copilot began flaring the aircraft for landing at Australia's Sydney Airport. The copilot increased pitch attitude and thrust, but the high sink rate continued until the Boeing 747-400 touched down hard on the runway.

At about the same time, the enhanced ground-proximity warning system (EGPWS) generated a wind shear alert, and the pilot-in-command (PIC) assumed control and initiated a go-around.

The second approach and landing proceeded without further incident. None of the 355 passengers and 19 crewmembers was injured in the April 15, 2007, incident. A few ceiling panels and light fixtures were dislodged during the hard landing, but there was no structural damage to the aircraft.

In a final report published in December 2009, the Australian Transport Safety Bureau (ATSB) concluded that the aircraft had "encountered significant horizontal wind shear associated with a dry microburst that commenced at about 120 ft radio altitude as the flying pilot began to flare the aircraft for landing."

Among other contributing safety factors cited in the report were the absence of a low-level wind shear alert system (LLWAS) at the airport[1] and the inconsistent handling by air traffic controllers of reported information that would have

© berbmit/fotolia

improved the 747 flight crew's knowledge about the wind and wind shear conditions they were likely to encounter during the approach.

Implied Risk

The 747 was being operated by Qantas on a scheduled flight from Singapore. The flight crew comprised the PIC, the copilot and two relief pilots.

"The PIC had 18,666 hours total flying experience and had been flying 747-400 aircraft for eight years," the report said. "The copilot had 16,972 hours total flying experience and had been flying 747 aircraft for nine years."

When the aircraft departed from Singapore, there was no indication that weather conditions at the estimated time of arrival in Sydney would cause any problems.

Shortly before the flight crew began their descent from cruise altitude at 1857 local time, they reviewed the latest routine weather report (METAR) for Sydney. Issued at 1830, the METAR indicated that the surface winds were from 030 degrees at 17 kt and that there were thunderstorms 18 nm (33 km) southwest of the airport, moving east-northeast at 15 kt.

"The associated trend-type forecast (TTF) indicated that between 1830 and 2000, there would be 30-minute periods during which thunderstorms, rain and associated low visibility and cloud would be present," the report said.

The Bureau of Meteorology (BOM) told investigators that the TTF did not specifically warn of low-level wind shear because "the risk of wind shear, which is a potential hazard associated with all thunderstorms, is implied when a forecast or warning of thunderstorms is issued," the report said.

During descent, the crew used their weather radar system to gauge the vertical extent of the thunderstorms. "The only significant buildup was … greater than 15 km [8 nm] south of the airport," the report said. "The radar showed no significant cells in the terminal area."

Air traffic controllers were inconsistent in providing current wind shear information to the fight crew.

Out of the Loop

Landings and takeoffs at Sydney Airport were being handled by two aerodrome traffic controllers (ADCs). "ADC West" was responsible for traffic using Runway 16R-34L. "ADC East" was responsible for Runway 16L-34R. Runway 34L and Runway 34R were in use.

As the 747 neared Sydney, the ADCs received several wind shear reports. The crew of a 737 reported overshoot wind shear[2] between 1,500 and 700 ft above ground level (AGL) on approach to Runway 34L. Another report of overshoot wind shear was made by a pilot who landed on Runway 34R. After hearing this report, another pilot on approach to that runway initiated a go-around.

Because they were on a different radio frequency, the 747 crew did not hear the reports when they were made or when they were relayed by the ADCs to the crews of other aircraft on approach or preparing for departure. One crew decided not to take off and taxied off the runway.

Significantly, the ADCs did not forward the wind shear reports to the Sydney Airport Meteorological Unit (SAMU). "Had the SAMU received details of the pilot reports of wind shear, it is likely that a SPECI [special report], highlighting the likelihood of wind shear, would have been issued prior to the arrival of VH-OJR [the 747]," the report said. "The availability of that information would have allowed the flight crew to better prepare for the likely conditions affecting their approach."

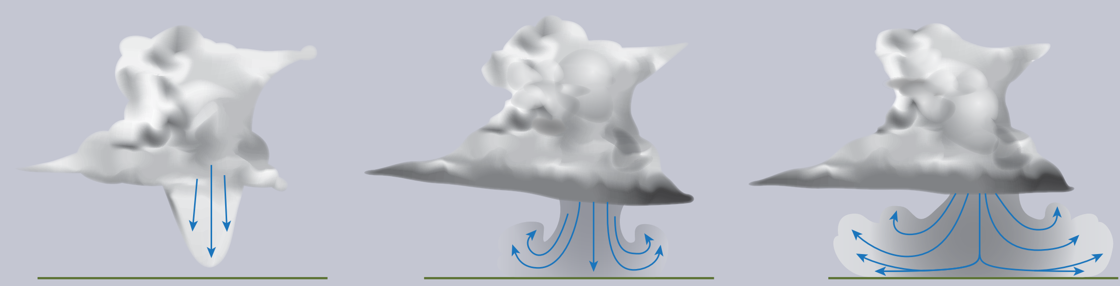
However, at 1908, the automatic terminal information system (ATIS) was revised to include the 737 crew's report of overshoot wind shear and to change the altimeter setting. The aerodrome traffic director broadcast the new information on the local frequencies.

The 747 crew was on an approach control frequency and did not receive the new ATIS information with the wind shear report. When they asked the approach controller for an update on weather conditions in the terminal area, they were told to stand by.

Rapid Wind Changes

The 747 crew did not hear the ADC West controller advise a departing crew that the indicated surface wind direction and velocity at the threshold of Runway 34R had changed from northerly and light to southerly and 20 kt.

Development Stages of Microbursts



Source: Wikipedia

Figure 1

They also did not hear another crew on approach to Runway 34R report that they were going around, or the ADCs' subsequent change of arrivals and departures to Runway 16L and Runway 16R.

At 1910, "the approach controller made a general broadcast that there were cumulonimbus clouds (thunderstorms) in the area," the report said. The controller then told the 747 crew that they could expect to land on Runway 16R.

At 1913, the ATIS information again was revised. The new broadcast, Romeo, stated in part that surface winds were from 190 degrees at 10 to 20 kt, visibility was greater than 10 km (6 mi) with showers in the area and scattered clouds at 4,000 ft.

The report said that ATIS Romeo should have included a wind shear warning. "That information was very relevant to the pilots of VH-OJR in endeavoring to conduct a safe approach and landing."

The approach controller provided the 747 crew with details of ATIS Romeo before handing them off to the traffic director.

At 1917, the traffic director told the crew to advise him when they had the airport in sight. The 747 was the first aircraft sequenced for landing on Runway 16R following the runway change.

'Expect Wind Shear'

ATIS Sierra was issued at 1918. Among the changes were notification of cumulonimbus clouds in the area and the statement: "Significant weather — expect wind shear below 3,000 ft."

The traffic director told the 747 crew to intercept the localizer for Runway 16R. The traffic director then relayed the significant weather advisory to all aircraft on his frequency.

At 1920, "the crew of the first aircraft to land on Runway 16L after the runway change reported to ADC East that they experienced 'quite a bit of shear on final approach,'" the report said. When ADC East asked for details about the encounter, the crew said that they had experienced overshoot wind shear followed by undershoot wind shear at 100 ft.

ADC East did not relay the details about the wind shear encounter to ADC West or to the SAMU.

The 747 was descending through 1,900 ft when the crew advised the traffic director that they had the airport in sight. They were cleared for a visual approach to Runway 16R and told to establish radio communication with ADC West.

The aircraft was about 3 nm (6 km) from the runway at 1922, when the crew told ADC West that they were on final approach to Runway 16R. "ADC West advised the crew that the wind at the landing threshold was 180 degrees at 22 kt, issued a clearance to land and requested a wind readout," the report said. "The crew reported that the wind at 1,000 ft was a 20-kt tail wind."

The copilot disengaged the autopilot and autothrottles at 780 ft AGL and asked the PIC for continuous callouts of wind data. The PIC's callouts indicated that the wind changed from the tail wind to a 15-kt head wind at 500 ft AGL and to an increasing right crosswind at 120 ft AGL.

'Storm Cell Outflow'

"Investigation revealed that the aircraft was influenced by outflow descending from a high-based storm cell that developed into a microburst," the report said.

According to the BOM, the base of the line of thunderstorms was about 12,000 ft. Moving from the southwest at 22 kt, the leading edge of the line reached the airport at 1920. The microburst that developed over the threshold of Runway 16R was most intense when the 747 was 3 nm from the runway, and it moved west as the aircraft neared the runway.

The approach had been stable until the 747 encountered overshoot wind shear followed by undershoot wind shear. Recorded flight data indicated that calibrated airspeed increased from about 146 kt to 159 kt at 120 ft AGL and then decreased at a steady rate during the next six seconds to 131 kt on touchdown. Reference landing speed was 144 kt.

The report said that the crew could not have prevented the hard landing. The recorded sink rate was 820 fpm, and vertical acceleration was 2.34 g when the main landing gear contacted the runway at 1923. The aircraft then apparently bounced.

The PIC's decision to go around was appropriate and in accordance with company procedure and training, the report said. "Recorded flight data showed a rapid forward movement of the engine thrust levers within two seconds of the initial touchdown. The PIC said that he did not select the TOGA [takeoff/go-around] switches but adopted the quicker method of manually advancing the thrust levers to achieve go-around thrust."

The aircraft touched down again with a vertical acceleration of 1.53 g before climbing away within seven seconds of the initial touchdown.

After the incident, Qantas maintenance technicians reattached five cabin ceiling panels and two emergency lights that had dislodged, and conducted a structural inspection of the aircraft. "That inspection did not reveal any abnormalities," the report said.

Warning Systems

The EGPWS was the only system aboard the 747 that could provide wind shear warnings. "However, because the system was reactive, and because the wind shear developed so quickly and occurred when the aircraft was at a very low altitude, the aircraft contacted the runway before the warning was triggered," the report said.

The weather radar systems in 12 of the 33 747s in the Qantas fleet had been equipped to provide predictive wind shear warnings. The equipment had not been fitted to VH-OJR. However, the report said that the equipment likely would not have detected the wind shear created by the dry microburst because it depends on measurements of changes in the velocity of moisture and particles in the air ahead of the aircraft.

Another warning system, air traffic control, did not provide sufficient and timely information to the crew, the report said. "The differences in the quantity and quality of wind and wind shear information that was provided to the flight crew by the aerodrome controllers revealed the limitations of human information processing and decision making in a rapidly changing situation."

© Andrew Hunt/AirTeam Images

This Boeing 747 experienced the microburst event.

The findings of the investigation prompted the BOM to launch a study of the need for an LLWAS at Sydney Airport. The report said that the study was to be completed in April.

This article is based on ATSB Transport Safety Report AO-2007-001: "Microburst Event; Sydney Airport, NSW; 15 April 2007; VH-OJR, Boeing Company 747-438."

Notes

1. At the time, no airports in Australia had an LLWAS.
2. Overshoot wind shear occurs when an aircraft encounters an increasing head wind, a decreasing tail wind or an updraft that causes an increase in indicated airspeed and/or a deviation above the desired flight path. The opposite holds for undershoot wind shear.

Anatomy of a System Failure

How seemingly small deviations conspired in an approach accident.

BY SHAWN PRUCHNICKI

The aviation system is designed with many layers of protection against accidents. Examples of this "system resilience" include established procedures and standards. When an accident does occur, we need to closely examine from a system point of view not only *what* happened but *how* and *why*.

This might require that we understand how seemingly innocuous events acted synergistically to produce the system's total failure. The goal is not to find blame when examining the relevant human behavior but rather to understand why the choices that were made by those involved seemed reasonable to them at the time. Affixing blame offers no leverage for change and hence no opportunity to strengthen system resilience.

With this in mind, let's re-examine the Oct. 24, 2004, crash of a Beechcraft King Air 200 at Martinsville (Virginia, U.S.)/Blue Ridge Airport. The aircraft departed at 1156 local time from its home base in Concord, North Carolina, for the short instrument flight rules (IFR) corporate flight to Martinsville.

During the en route portion of the flight, the flight crew reported no problems to air traffic control (ATC). Upon reaching the Martinsville area, the crew was advised that they were second in sequence for the localizer approach to Runway 30.

ATC directed them to hold as published on the approach chart at the BALES locator outer marker at 4,000 ft and advised them to expect a 28-minute delay because of the preceding aircraft.

The crew reported entering the hold at 1224 while turning outbound in the holding pattern over BALES. Seven seconds later, they were cleared for the approach and told to report inbound.

The King Air crossed BALES inbound at 4,000 ft — 1,400 ft higher than the charted crossing altitude of 2,600 ft (Figure 1). The aircraft was 2 nm (4 km) past BALES — and 3 nm (6 km) from the end of the runway, where the missed approach point (MAP) is located — when the crew began a descent from 4,000 ft. They passed through 2,600 ft as they passed the MAP.

Radar Target Lost

About 1 nm (2 km) past the MAP, the crew began a further descent to 1,400 ft — 60 ft above the minimum descent altitude (MDA). The aircraft stayed at this altitude for about a minute until it was 8 nm (15 km) past the end of the runway, where the crew began a straight-ahead climb.

The crew reported the missed approach at about 1233 and was directed by ATC to maintain 4,400 ft. Three seconds later, the ATC radar target was lost.

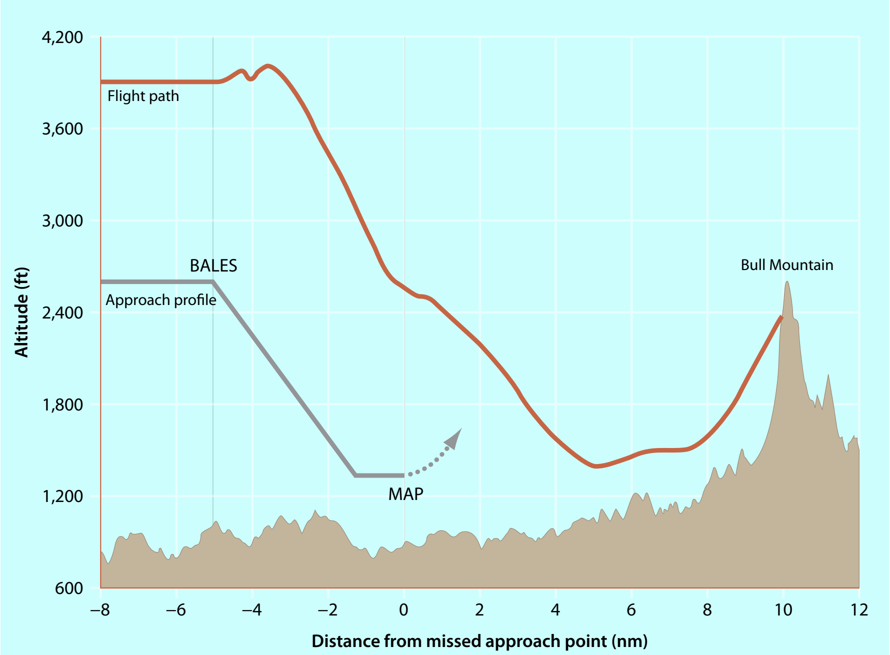
The wreckage was found the next day at 2,400 ft on Bull Mountain in Stuart, Virginia. Both pilots and the eight passengers had been killed.

Meteorological conditions recorded at the airport 15 minutes prior to the accident included calm winds, 5 mi (8 km) visibility and an overcast at 600 ft. A witness said that Bull Mountain was obscured by clouds and fog.

The U.S. National Transportation Safety Board (NTSB) concluded that the probable cause of the accident was "the flight crew's failure to properly execute the published instrument approach procedure, including the published missed approach procedure, which resulted in controlled flight into terrain."[1]

NTSB also said, "Contributing to the cause of the accident was the flight crew's failure to use all available navigational aids to confirm and monitor the airplane's position during the approach."

King Air Flight Path



Source: U.S. National Transportation Safety Board

Figure 1

In visual conditions, Bull Mountain is a prominent feature on the extended centerline of Runway 30 at the Martinsville airport.

Closer Look

That told us what they failed to do, but the really important question is *why*. Let's take a closer look at the information provided in the NTSB final report.

The captain, 51, had been with the company more than three years. He had over 10,000 hours total time, with 210 hours in King Airs and 8,600 hours in Beech 1900s. Interviews with company personnel indicated that he was well liked, but one pilot said that she did not like to fly with him and that other pilots felt the same way. She said that he never wore his eyeglasses, although his medical certificate required them, and had a hard time reading navigation charts.

The first officer, 31, had been with the company almost three years. She had just over 2,000 hours with 121 hours in King Airs. She was described by fellow employees as easy to work with. No one expressed any concern about her flying abilities.

The pilots likely used a global positioning system (GPS) receiver as their primary navigation instrument during the approach. However, it was not certified for IFR navigation because the database was not current.

The descent profile that the crew flew was correct, except that they were 5 nm (9 km) off because they misunderstood the locations of BALES and the MAP. The aircraft did not have, and was not required to have, a cockpit voice recorder, so we can only speculate on how this happened.

To say that the pilots lost situational awareness would oversimplify the explanation and provide no true understanding of how this event unfolded. We must ask why they thought their flight path was correct and what systemic factors allowed this misperception to continue without correction.

First, let's examine the location of the GPS receiver, a Bendix/King KLN 90B. The unit was on the center pedestal between the seats, in the proximity of the pilots' elbows. To view the GPS display, each pilot would have to look 90 degrees sideways and downward. It is reasonable to assume that the location of the GPS receiver would have increased the already high workload of a nonprecision approach to minimums in instrument meteorological conditions (IMC).

Although it was stated company practice to use the GPS only as a supporting navigational device, the aircraft's flight profile strongly suggests that it was used as the primary navigational device.

Tipping Point

Past success in using a GPS that is not IFR-certified or has an out-of-date database as a primary source of information for IFR operations promotes future usage — and that is where the danger lies. In addition to the risks inherent in the outdated database, there is the possibility that other navigational aids might not be used adequately for course guidance.

Although it might seem to be a harmless transgression, a procedural deviation such as this could be the tipping point of a hazardous event that is developing without the crew's knowledge.

As part of the investigation, an NTSB official observed company pilots conduct the approach in an aircraft equipped with a KLN 90B. The demonstration flight revealed that as the accident aircraft crossed BALES and was turned to enter the holding pattern, the GPS unit would have autosequenced from the BALES waypoint to the next waypoint entered by the crew. NTSB said that waypoint likely was the airport. It is plausible that neither pilot recognized that the GPS had autosequenced to the airport waypoint.

The crew was expecting a 28-minute delay but were cleared for the approach while completing the procedure turn outbound at 4,000 ft. One can only wonder how well the approach was briefed at this point, considering the crew's mindset from the expectation of a significant delay.

Deadly Expectations

Another consideration in understanding the crew's mindset is that ATC also advised them that the pilot of the preceding aircraft had reported that he "broke out just below minimums [and had] good visibility below." This might have led the King Air crew to expect the same. Such a strong mental model of the environment can be a very powerful primer in forming expectations that affect our decision making and actions.

Was the crew really ready to begin the approach? Or did reliance on the GPS and the success of the previous aircraft in completing the approach suggest a guaranteed positive outcome? Such an expectation can be deadly in instrument conditions.

Now established inbound with a GPS that had autosequenced — without their knowledge — to the next waypoint, which was probably the airport, they began their descent to 2,600 ft as if they were still outside BALES. At this point probably nothing seemed amiss. They were approaching what they thought was BALES and were descending to the published crossing altitude.

The problem was that the aircraft had actually passed BALES before the descent to 2,600 ft was initiated. Unaware that a missed approach was in order, the crew continued until passing the next fix, which they thought was BALES. They began a descent to the MDA, 1,340 ft, and maintained a slightly higher altitude until they were well beyond the approach end of the runway.

Their persistence in staying at 1,400 ft as long as they did, apparently without navigational data for the MAP, might have been encouraged by a mindset based on the report by the pilot of the preceding aircraft of breaking out with good visibility. Perhaps they were expecting to see the airport any second. Maybe both pilots were looking outside, trying to find the runway, while in IMC and knowingly very close to the ground.

Eventually, they declared a missed approach. They climbed straight ahead instead of turning right, as prescribed by the approach chart for the missed approach procedure, and struck rising terrain at about 2,400 ft.

Treacherous Synergy

It is important to understand that none of the crew's actions in isolation was egregious enough to "cause" an accident. In fact, most of the decisions were based on what they thought was their correct location on the approach. Small variables — like having only one approach chart, the awkward location of the GPS receiver, the possibility that the captain was not wearing his eyeglasses, and the procedural deviation of using the GPS as the sole source of navigational data — created the synergy for an accident.

This is the nature of a system accident. It is not linear in causation; one event does not cause another event, and so on. A pilot can make seemingly innocuous deviations hundreds of times without event, which only serves to encourage similar decisions in the future. But, in reality, we never know how close we might already be to an accident; and these deviations further erode the built-in margin of protection until the system as a whole fails.

Sometimes, we deviate from standards to resolve conflicting goals and make the best of a bad situation. But, other times, it appears to those on the outside looking in that there is no clear answer to why a procedure was not followed. It does not mean that an answer does not exist but rather that we might be biased by the negative outcome of this event, making its absolute determination impossible.

Everyday practices and imperfections in our operations, plus the daily compromises practitioners must make in these systems — for example, having only one set of approach charts aboard the aircraft, or having important instruments in hard-to-see locations — can suddenly become very dangerous, preventing the capture of, and recovery from, an error that we may not have identified.

It is incumbent upon all of us to understand that, like the King Air crew, many pilots who have crashed probably had no idea that an accident was about to occur. They had no idea how much of their safety net had already eroded around them when they made seemingly innocuous choices based on the information in hand.

We should never intentionally give up a layer of protection and safety, because it might be the last one we have. We must follow the procedures and guidance provided for our operations, because someday we might have no idea how close we are to an accident.

Shawn Pruchnicki, a former airline captain and accident investigator, operates a human factors investigation and education company. A doctoral candidate, Pruchnicki also teaches system safety, human factors and accident investigation at The Ohio State University.

Note

1. Aircraft Accident Brief NTSB/AAB-06/01.

With safety management systems deemed essential in aviation, suggestions that risk analysis takes too long would seem out of line. In the context of accelerating implementation of the Next Generation Air Transportation System (NextGen) in the United States, however, the streamlining of risk analysis emerged as one of several safety-related issues raised by 50 speakers and panelists at the RTCA Spring Symposium, held April 6–7 in Washington, with about 350 attendees from the aviation industry and the U.S. Federal Aviation Administration (FAA).

The event also covered issues such as global compatibility of technology, incentives for air carriers to equip aircraft, business cases, and political and environmental constraints.

Most of the symposium was devoted to how the FAA has adopted 28 recommendations of the 300-member RTCA NextGen Mid-Term Implementation Task Force, also called Task Force 5, which were issued in September 2009 and incorporated into the *FAA NextGen Implementation Plan* of March 2010.

Basically, NextGen is a comprehensive overhaul of the U.S. National Airspace System (NAS), which is already beginning to add capabilities that make air transportation safer and more reliable, increase the air traffic capacity of the NAS, and reduce the impact of aviation on the environment, the FAA says. Details of the next phase of formal interaction between the FAA and industry will be announced in May by the FAA NextGen Management Board.

BY WAYNE ROSENKRANS

NextGen *Safely*

Risk management shapes how fast transformation of the U.S. aviation system will occur.

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Near-term NextGen plans call for RNAV (GPS) and RNP approaches enabling closely spaced parallel operations.

"We can't afford not to move forward with NextGen," FAA Administrator Randy Babbitt told the symposium participants. "Let me say with emphasis: NextGen is under way. We are en route. We are not in the planning stages. We are airborne with this, and we can't afford to lose time. We need NextGen now and 'now' as in right now."

FAA acceptance of most task force recommendations signifies a critical consensus about mutual priorities, he added. "Now we are all tracking to true north on the same compass," Babbitt said. "RTCA has collectively given the FAA the priorities that we need to set — like implementing closely spaced parallel approach sequencing and, for operations at critical airports, going as far as integrated traffic management."

Sandy Samuel, vice president of transportation solutions, Information Systems and Global Services, Lockheed Martin, distilled a key industry concern. "From the data communications perspective, we could lay the whole infrastructure in place, but we know there's this big public policy decision to be made about who should pay for [aircraft] equipage," Samuel said. "I don't really think it [could] be the technology that delays NextGen. I think it could be [making] some of the hard policy decisions … before we get too far down the implementation path and then have to start over or stop altogether."

Safety Perspectives

Brian Townsend, a captain in flight technical operations at US Airways, characterized the new *FAA NextGen Implementation Plan* as "heavily weighted toward research and data collection." He expressed concern about potential duplication of effort in the name of safety. "We need to use a lot of the information that we have," Townsend said. "We certainly don't want to skip over the safety aspect — that's extremely important to maintain in focus before we take the necessary [implementation] steps — but at some point we do have to take the plunge. We also need to take a very close look at the safety risk management process and make certain that, in some respects, it's not hindering some of the progress even though it's a very important component. From some of my observations and experiences, at times it can really tend to hold us back."

Operators bear the ultimate responsibility for safely moving passengers, crews and cargo, said Rip Torn, a Delta Air Lines captain and chairman, Air Traffic Services Group, Air Line Pilots Association, International. "No one will say, 'We need safety to be the second, third or fourth [priority],'" he said.

U.S. aviation has a long track record of identifying human-in-the-loop risks early by thorough study before implementing changes to the NAS, Torn said. "Once a safety study is done and we start trapping the errors and coming up with risk mitigations, we get buy-in — people want to stick their toes in the water and try new procedures," he added.

Bruce DeCleene, manager, avionics systems, FAA, said NextGen activities have been a major challenge so far for FAA aircraft certification offices. "We are resource-limited," DeCleene said. "There have been times when installation of these technologies had to sit while we worked on other higher-priority projects. We are putting in place a change to our prioritization criteria so that our highest-priority projects will always be safety-related, such as something based on an airworthiness directive or something unsafe. Then, immediately beneath that, there will be the alterations to an aircraft in support of a national NextGen-related initiative."

The key to full industry support of NextGen implementation will be definable benefits that must begin to be shown "this year or very soon," said Ken Speir, a captain and Atlanta chief pilot at Delta. The industry wants to see teams assigned to *metroplexes* — that is, 23 multi-airport urban areas anchored by the nation's 35 busiest airports — begin their work without delay, he added.

Risk analysis under safety management systems and environmental impact studies ranks high among the aviation community's concerns, Speir added. "I don't know how we will get through the safety-management activities, as

NextGen Timeline Excerpts

FY 2010

- Final regulation requiring ADS-B Out avionics.
- Acceleration of FAA process for developing RNAV and RNP procedures.
- Final SMS risk analysis of required time of arrival capability.
- Study of pilot blunder model, wake turbulence and target level of safety for closely spaced parallel operations.
- Final human error safety analysis of NextGen ATC operations in 2012–2018.
- Air traffic safety action plan to consistently achieve 3.0-nm and 5.0-nm (5.6-km and 9.3-km) separation.

FY 2011

- Data exchange capability enables ATC predeparture reroutes.
- First RNAV (GPS) and RNP approaches with closely spaced parallel operations for landing.

FY 2012–2015

- National ADS-B ground receiver infrastructure completed.
- NAS-wide airborne traffic and flight information services.
- Data exchange capability enables ATC airborne reroutes (2014).
- Performance-based navigation capabilities expand to begin linking U.S. metroplexes.
- Limited 4D FMS trajectory-based operations begin.
- Collaborative air traffic management with operators begins.
- Conflict-resolution methods established using aircraft intent data.
- ADS-B surface alerting capability enabled.
- Final human factors analysis of NextGen arrivals, including required time of arrival.
- Final rights and release policies for FAA surface and en route data sharing with operators.
- Final safety case studies on closer runway spacing for simultaneous independent approaches.
- Final R&D for combinations of RNP and ADS-B paired approaches for closely spaced parallel operations.

FY 2015–2018

- Complex and revised RNAV departure clearances via ATN (2016).
- Airborne reroutes enabled via data communication for equipped aircraft (2016).

4D = four-dimensional (latitude, longitude, altitude, time); ADS-B = automatic dependent surveillance–broadcast; ATC = air traffic control; ATN = aeronautical telecommunications network; FAA = U.S. Federal Aviation Administration; FMS = flight management system; FY = federal fiscal year (Oct. 1–Sept. 30); GPS = global positioning system; NAS = U.S. National Airspace System; NextGen = U.S. Next Generation Air Transportation System; R&D = research and development; RNAV = area navigation; RNP = required navigation performance; SMS = safety management system

Source: *FAA NextGen Implementation Plan*, March 2010

Figure 1

well as the environmental issues, to really get everything that we need to get out of NextGen."

Real-world implementation will reveal unanticipated safety issues, he said. "I was very involved in the area navigation [RNAV] implementation in Atlanta, for example," Speir said. "Never in a million years would we have believed [before implementation] that the no. 1 obstruction to RNAV off the runway or RNAV standard instrument departure [SID] and standard instrument arrival [STAR] applications actually was the pilot putting the correct runway into the flight management system [FMS]. If we can't do RNAV off the runway today, how are we ever going to make the NextGen of 2018 a reality?"

FAA Air Traffic Organization (ATO) terminal personnel in Atlanta told the National Air Traffic Controllers Association (NATCA) that FMS programming errors by pilots have led to 13 turning errors out of 250,000 RNAV off the runway departures, responded Dale Wright, NATCA's director of safety and technology. "What [the errors] boiled down to was that runways were changed, and the pilots had the RNAV [procedure in the FMS] but did not have the correct runway in [the FMS]," Wright said. "[Atlanta tower] controllers are keeping their airplanes on their frequencies longer and making sure pilots turn the right way, or they ensure pilots are on the right departure.

"Typically, most of the performance-based navigation [PBN] errors we've had … have been a gradual conflict, very controllable, [because of inherent] increased levels of safety as opposed to errors that might have been more drastic in the 'pre-PBN' world."

Controllers need to be trained appropriately but also need confidence that the pilots in their airspace have been trained to correctly conduct RNAV and required navigation performance (RNP) procedures. Air traffic control (ATC) also needs to be able to determine, from a glance at tags accompanying aircraft targets on their displays, how aircraft are equipped for NextGen capabilities. "That way, the controller remains focused on the scopes, not looking around with attention diverted," Wright said.

Written consensus about launching metroplex-level teams is tangible evidence of progress, said Chris Oswald, vice president, safety and technical operations, Airports Council International–North America. "We will have multiple [metroplex] test beds — whether two or five or 10 initially — and ways to adjust what we are doing with NextGen to reflect real-world, local situations, such as the ways that runway flow configurations operate in a particular metroplex," Oswald said.

"The safety risk management piece … is essential, but we need to approach it realistically. How much time is that really going to take as we get into each of these metroplexes? Are there ways that … those processes can be streamlined without compromising safety? You can't model all of the airport detail, all of the weather conditions or all the flow configurations."

Metroplexes and Misalignments

The following examples show how the few gaps and misalignments between the task force recommendations and the FAA's latest implementation plan shaped the discussions. The recommendation that called for the agency to integrate and optimize airspace and procedure design at a task force–identified subset of metroplexes seeks traffic deconfliction of airports, RNP with radius-to-fix capability (that is, curved flight paths) and expanded use of ATC terminal separation, said Gisele Mohler, manager, airspace and PBN integration, ATO System Operations, FAA.

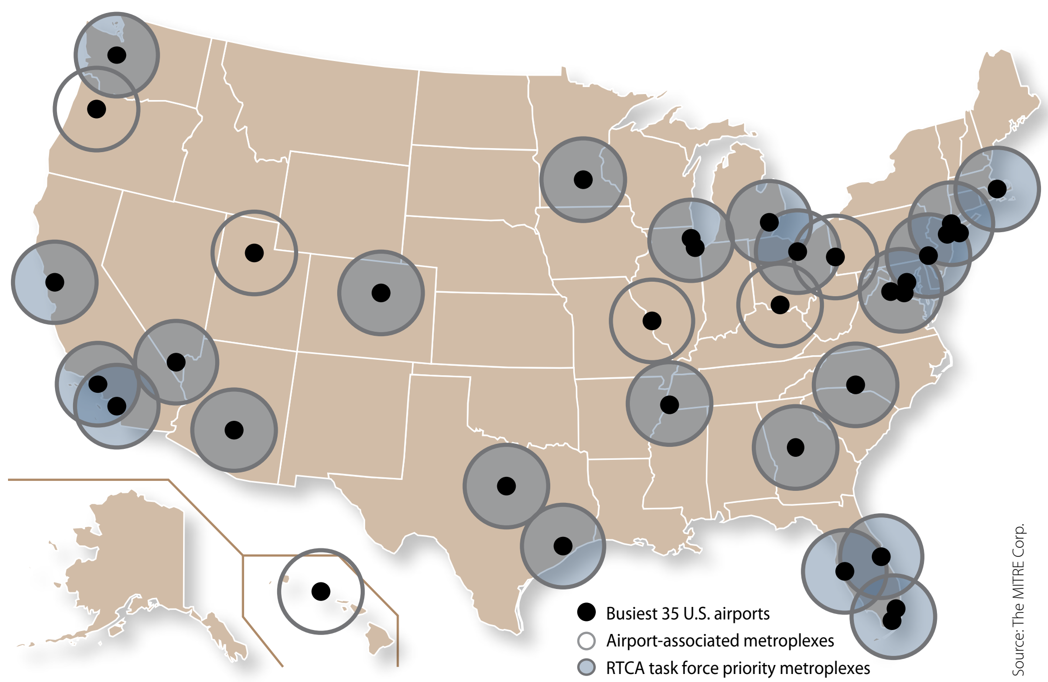
Metroplexes became such a major focus of task force efforts because of delays and inefficiencies that have developed where multiple airports in close proximity compete for the same airspace, and traffic loading and flow imbalances exist across egress and ingress routes, runways and city pairs, explained Lillian Ryals, director, system operations, safety and performance, The MITRE Corp.

Among locations considered NextGen proving grounds, Ryals cited RNAV at Atlanta-Hartsfield International Airport; optimized profile descents at Phoenix Sky Harbor Airport in Arizona; integrated airspace and routes built around an optimal set of RNAV SIDs and STARs at Denver International Airport; advanced aircraft equipage for PBN at Chicago O'Hare International Airport, including RNP applications to prevent conflicts among Chicago Midway Airport arrivals and O'Hare departures; and expedited west gate departures with higher and faster initial climb in the New York metroplex.

"Metroplex-related recommendations call for automation that helps controllers in metering, monitoring and merging traffic along RNAV arrival routes," Ryals said. "We also understand that metroplex operations are interconnected end to end across all phases of flight, including surface operations, access to airport airspace and runways, and cruise and cross-cutting capabilities [that is, leveraging integrated air traffic management and data communications]."

Victoria Cox, senior vice president, NextGen and Operations Planning Services, FAA ATO, noted why metroplex selection is pending. "We do intend to identify specific locations, but … we've got to conduct business and safety assessments of capabilities. … Some of the recommended locations for some capabilities, particularly locations with low traffic volume, may

In 2012–2018, NextGen plans call for introducing new capabilities on the basis of multi-airport U.S. metroplexes.



Source: The MITRE Corp.

not prove to be cost beneficial and may not get selected for implementation."

The FAA's Mohler emphasized that the agency will move forward "expeditiously and prudently" on establishing the metroplex teams, however. Over roughly a 24-month period, each team will have a common toolbox; a subgroup that quantitatively and qualitatively assesses current operations, and explores potential improvements; and a decision-making subgroup. The second subgroup will prioritize NextGen changes based on the assessment, available resources and constraints, then select target activities for FAA design and implementation teams.

Elizabeth Lynn Ray, director, airspace and aeronautical information management, FAA, cautioned against expecting perfectly implemented NextGen capabilities in metroplexes. "We are not going to get a perfect answer for every metroplex but collectively … we will come up with a 75- or 80-percent solution that will multiply over time. From the airspace and PBN perspective, this metroplex work easily could be 75 to 80 percent of the entire [NextGen] work plan."

In response to the recommendation for increased use of parallel, staggered and converging runway operations, the FAA is upgrading ATC displays with runway path indicators, a major software change to terminal operation systems that will provide greater benefits but over a longer time than requested, said Leo Eldredge, manager, Global Navigation Satellite System Group, ATO Technical Operations, FAA. The FAA also will begin the phase-in of closely spaced parallel operations, including staggered approaches, at Newark, Memphis and Seattle, and will investigate Washington Dulles International Airport and Denver.

"Flying airplanes close together on final approach is subject to what the blunder of one aircraft [pilot] can do to the other aircraft flying in parallel operations," Eldredge said. "There is no guarantee that there will be a positive outcome [from analysis under] a newer target level of safety."

One related recommendation called for using multilateration — that is, determining aircraft position using time difference of arrival of transponder signals at multiple antenna sites — as a replacement or substitute for ATC precision runway monitoring radar to enable closely spaced parallel operations. "We are going to collect [proprietary Detroit, Michigan,] data and also look at Atlanta as a possible source of data, and have a business case established before we take the next step to establish multilateration as an FAA program," Eldredge said.

The FAA's work on these ideas had begun even before the 2009 task force was convened, noted Margaret Gilligan, associate administrator for aviation safety, FAA. "Clearly, technology offers us the opportunity to make the safety case for a closer spacing between parallel runways — safely. … We have taken a scientific approach, collecting new data, and trying to better understand the issue of pilot blunder, how that plays [into risk] and how we can be sure we can protect the airspace necessary to assure the level of safety that we have presently. At the same time, we'll look at whether the distances that we have set now are necessary. Whether they come down to a 700-ft [213-m] standard — I don't know yet."

Another recommendation sought to establish satellite-based navigation as equivalent to an instrument landing system (ILS) for purposes of widely and closely spaced runway operations. "There are over 2,000 LPV [localizer performance with vertical guidance] approaches and over 4,000 global positioning system–based RNAV approaches in the NAS today," the FAA's Eldredge said. "Our plan is to complete the safety risk management this year, and to do it as fast as we can."

Kip Spurio, system engineering manager and chief system engineer, ATO Terminal Services, FAA, told the symposium participants that the recommendation to initiate surveillance in the non-movement areas of airports is being studied in light of the FAA's deployment of other surface-surveillance systems and its new capability for data dissemination.

"There are a lot of questions around data release," added Teri Bristol, vice president, technical operations services, FAA. "Near-term, we're making changes to [FAA Order 1200.22D, "FAA National Airspace System (NAS) Data and Interface Equipment Used by Outside Interests"] to streamline [decisions] in the environment we are in today. There are a lot of different classes of users, and different people need information for different things. We also follow processes that determine how we share data, how we release data and who needs access to data."

Surveillance cannot be introduced in some metroplexes as recommended, however, said Stephen Ryan, senior system engineer, ATO Terminal Services, FAA. Aside from the unresolved data-sharing policy, the reason is that the FAA first will have to complete its 2012–2018 mid-term roadmap of air traffic management capabilities and upgrade its traffic flow management system. This is the same system that later will introduce electronic negotiation of flight paths between aircraft pilots and ATC. Nevertheless, the FAA agreed to work on data-sharing frameworks.

To read an enhanced version of this story, go to the FSF Web site <www.flightsafety.org/asw/apr10/rtca-nextgen.html>.

Poor Planning

The NTSB says a Bell 222 HEMS pilot's inadequate preflight planning was responsible for his helicopter's collision with a radio tower.

BY LINDA WERFELMAN

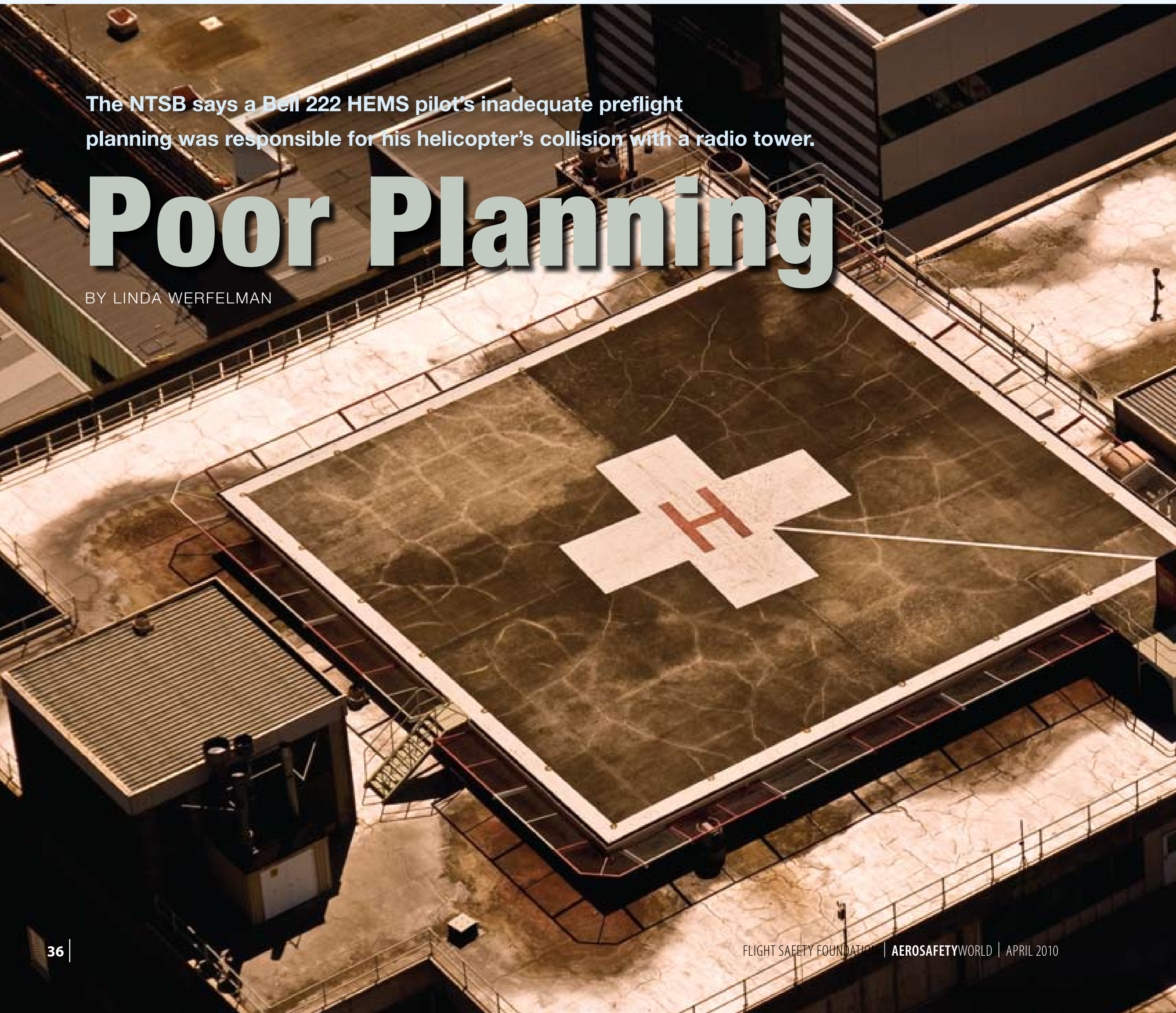
A Bell 222 was on a helicopter emergency medical services (HEMS) nighttime flight to transfer a 14-month-old patient from one hospital to another when it struck a radio station tower in Aurora, Illinois, U.S., plunged to the ground and burned.

All four occupants were killed, and the helicopter was destroyed in the crash just before midnight on Oct. 15, 2008 — one of a cluster of fatal HEMS crashes that year.

The U.S. National Transportation Safety Board (NTSB) said in its final report on the accident that the probable cause was the pilot's "failure to maintain clearance from the 734-ft-tall lighted tower during the visual night flight due to inadequate preflight planning, insufficient altitude and a flight route too low to clear the tower."

The NTSB cited as a contributing factor the air traffic controller's "failure to issue a safety alert as required" by U.S. Federal Aviation Administration (FAA) Order 7110.65, *Air Traffic Control*.

The helicopter, operated by Air Angels, departed from the company's base in Bolingbrook, Illinois, about 2254 local time, more than one hour 40 minutes after the dispatcher, Reach Air Medical Services in Santa Rosa, California, was notified of the need for EMS transport and Air Angels accepted the flight.



The pilot's most recent recurrent training was in August 2008.

At 2311, the helicopter arrived at the Valley West Hospital Heliport (0LL7) in Sandwich, Illinois. At 2338, as required by Reach/Air Angels protocol, the pilot contacted Reach dispatch with a flight following call that provided information about the helicopter's takeoff weight and balance information, the fact that it would carry four occupants and 1.5 hours of fuel, and the planned initial heading of 080 degrees for the 38-nm (70-km) flight to Children's Memorial Hospital Heliport (40IS) in Chicago, which was expected to take 18 minutes. After he completed the call, the pilot conducted the takeoff from Sandwich.

At 2355, the pilot reported to the DuPage Airport air traffic control tower that he was "over Aurora" at 1,400 ft. Radar showed the helicopter was about 12 nm (22 km) northeast of 0LL7 at the time on a 072 degree magnetic course. Radar showed that the course remained the same and the helicopter continued at a "constant altitude of 1,300 ft" until the radar track ended at 2358 at the radio station tower.

© Dave Greenberg/Dreamstime.com

Hired in 2006

The pilot held a commercial pilot certificate with rotorcraft–helicopter and instrument ratings; he also held a private pilot certificate for single-engine land airplanes. His second-class medical certificate specified that he must wear corrective lenses for near and distant vision.

He was hired in July 2006 by Air Angels, and company records showed that he had 3,565 flight hours, including 3,183 hours in helicopters. While working for Air Angels, he accumulated 283 hours in Bell 222s. He flew 23 hours in the 30 days preceding the accident, and in October 2008, he flew six hours at night and conducted 20 night landings in Bell 222s.

The pilot's most recent recurrent training was in August 2008, and his most recent annual line check was completed on Sept. 25, 2008.

Because the pilot lived in Carmel, Indiana, about 200 mi (322 km) southeast of the Air Angels base, he did not commute during his duty weeks. Instead, he stayed in an Air Angels bunk room. When the accident occurred, the pilot was "one day into his second week of night shift work," the report said, noting that the pilot had not flown the night before the accident and that his most recent assignment had been a 54-minute flight on Oct. 13.

The helicopter was acquired by Air Angels in 1999 and had about 5,300 hours total time. It had two Honeywell (Lycoming) LTS-101-650C engines; the no. 1 engine had 5,694 hours and the no. 2 engine, 3,717 hours. The last phase inspection was conducted Sept. 24, 2008, when the airframe had 4,271 hours. Information provided by the pilot to Reach Dispatch indicated that the helicopter was within weight and balance limits.

The helicopter was equipped with a Garmin GNS 430 — a global positioning system (GPS) receiver, combined with navigation and communications radios — that was configured with the Jeppesen aviation database. The Air Angels director of flight operations told accident investigators that the GNS 430 was the primary source of navigation information for Air Angels pilots. The device was capable of displaying terrain and obstacles, but the software for that function was not installed.

Operator

Air Angels was an on-demand air taxi operator operating from Clow International Airport in Bolingbrook and serving northern Illinois and northwestern Indiana. The company was established in 1998 and acquired in 2007 by Reach Medical Holdings, a California company that operates medical transport companies throughout the United States.

Air Angels flights were dispatched by Reach Air Medical Services, which typically contacted the duty pilot by cell phone in response to a request for medical transportation and provided a briefing on sending and receiving facilities. The pilot then checked the weather and told the dispatcher whether to accept or reject the flight. The pilot was not required to perform a formal risk assessment, the report said. After a flight was accepted, the dispatcher briefed the medical crew about the patient's condition.

In the air, the pilot communicated with dispatch by radio and a Voice over Internet Protocol" connection to Santa Rosa. A call was required before takeoff, and a position report was required every 15 minutes to provide information about latitude, longitude, estimated arrival time, groundspeed and heading.

Air Angels operated under U.S. Federal Aviation Regulations Part 135, "Commuter and On-Demand Operations," with authorization for visual flight rules (VFR) operations involving no more than nine passengers. Part 135 flights under instrument flight rules were not authorized.

At the time of the accident, Air Angels operated two Bell 222s and employed three pilots; the chief pilot had left his job the week before the accident, and the director of air operations had temporarily taken over the chief pilot's duties.

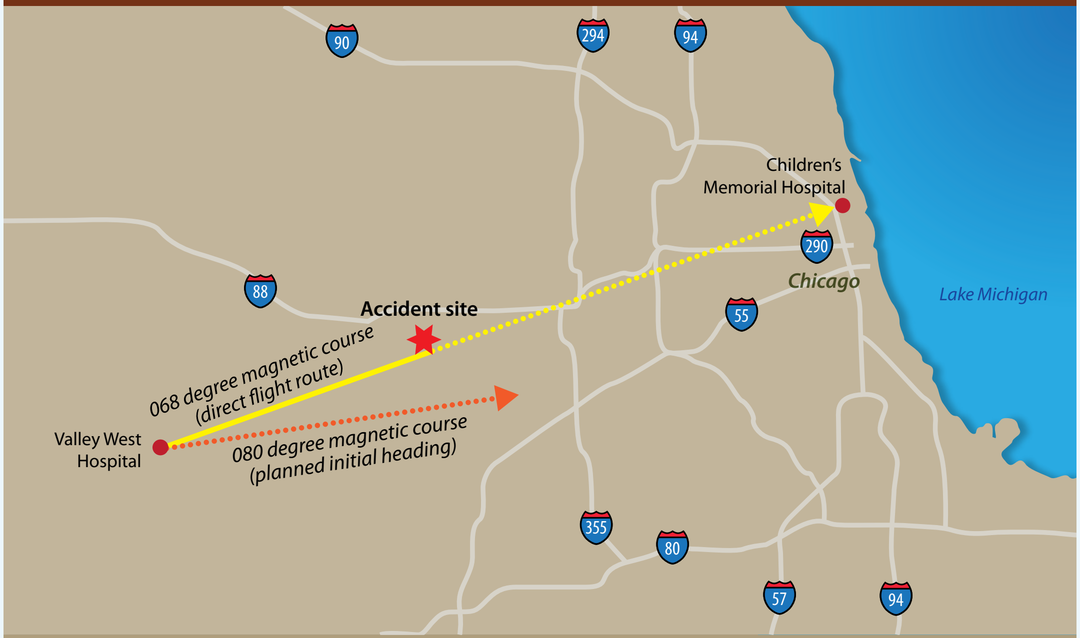
Air Angels pilots usually were scheduled to work 12-hour shifts — either from 0700 until 1900 or from 1900 until 0700 — for seven consecutive days, followed by seven days off; the duty schedule typically called for one week of daytime work alternating with one week of nighttime work. However, the director of flight operations had asked the other two pilots to perform extra work until the chief pilot's position could be filled. The accident pilot had agreed to work an additional week on the night shift.

The pilot had contacted DuPage Airport's air traffic control tower at 2355:21, saying that the helicopter was "just over Aurora en route to Children's Hospital, ah, downtown Chicago at about 1,400 feet."

The controller responded that the pilot was cleared through the airport's Class D airspace and provided altimeter information. The pilot acknowledged the information at 2355:42.

The report said that at 2358:26, an unidentified transmission "similar to 'ahhhhh'" was heard on the radio frequency and that there was no further contact with the helicopter.

Route of Accident Flight



Source: U.S. National Transportation Safety Board, Susan Reed

Figure 1

Radar Track

The radar display at the DuPage air traffic control tower showed one aircraft with a position and track that corresponded to the accident helicopter's direct track from 0LL7 to 40IS, at an altitude between 1,300 and 1,400 ft. The radio station tower was "in line with the flight path depicted by the recorded radar track," the report said. The final radar return was at 2358:25.

The helicopter struck the ground within a forest preserve, about 1,250 ft (381 m) from the radio station tower in a flat area covered with 6-ft-tall (2-m-tall) prairie grass. Parts of the upper vertical structure of the 734-ft (224-m) tower buckled with the impact, which also severed the uppermost guy wire on the west side of the tower. The conduit for the electrical wiring that supplied power for the tower's high intensity strobe lights also was severed about 50 ft (15 m) from the top of the tower.

Investigation

Weather at nearby airports at the time of the crash included visibility of about 10 mi (16 km). Skies were clear to the north and west of the accident site; to the northeast, there was an overcast ceiling at 3,300 ft and to the southeast, a broken ceiling at 1,900 ft and an overcast at 2,400 ft.

Investigators who examined the wreckage found no indication of any defect in the helicopter that existed before the crash. The helicopter was not equipped with a terrain awareness and warning system, and the pilot was not using a night vision imaging system.

Video from a nearby train station surveillance camera showed that the tower's strobe lights were functioning until about the time of the accident.

As part of the investigation, a simulation conducted by Honeywell International using their helicopter terrain awareness and warning system (H-TAWS) indicated that the system "could have provided the pilot a 'Caution Obstacle' prompt about 34 seconds before impact with the tower and a 'Warning Obstacle' prompt about 23 seconds before impact," the report said.

Although the DuPage Airport air traffic controller provided the current altimeter setting and cleared the pilot through the airport's airspace, he provided no specific instructions about the route of flight "because the pilot was flying under [VFR] and had chosen his specific route of flight on a direct course from the departure point to the destination," the report said, noting that during his preflight planning, the pilot should have identified obstacles along the planned route, including the radio station tower.

"While the NTSB recognizes that it was the pilot's responsibility to see and avoid the radio tower, the controller also had a responsibility to issue an alert as required by FAA directives," the report said. The NTSB cited FAA Order 7110.65, paragraph 2-1-6, which says controllers should issue safety alerts to pilots "if they are aware that the aircraft is at an altitude that places it in an unsafe proximity to terrain, obstructions or other aircraft."

Order 7110 specifies that issuance of safety alerts takes priority over other controller tasks, such as administrative duties — which were occupying the DuPage controller as the accident helicopter passed through his airspace. The report said that the controller's failure to notice when the helicopter disappeared from his radar display was an indication that he "was not monitoring the aircraft's progress sufficiently to watch for hazards and issue safety alerts."

NTSB Vice Chairman Christopher Hart disagreed with the Safety Board's designation of the controller's action as a factor that contributed to the accident.

"VFR pilots should continue to receive the clear, unambiguous and unequivocal message [that] … seeing and avoiding obstacles is solely and exclusively the responsibility of the pilot-in-command — with no exceptions," Hart said.

'Seeing and avoiding obstacles is solely and exclusively the responsibility of the pilot-in-command.'

In this case, the accident pilot did not ask the controller for flight following or VFR advisories — requests that typically are interpreted as requests for information about other aircraft — but "merely requested … to transit the controller's Class D airspace," Hart said.

In the report, the NTSB noted six related safety recommendations issued to the FAA before the accident, including a call for all EMS operators to implement flight risk evaluation programs.

This article is based on NTSB accident report CEN09MA019 and accompanying docket information.

Eurocontrol aims to implement a continent-wide plan to reduce the risks of airspace infringement.

Keep Out

BY LINDA WERFELMAN

Eurocontrol has approved a plan to fight airspace infringement — the unauthorized penetration of airspace, often by general aviation (GA) aircraft being flown under visual flight rules (VFR) — which it characterizes as a leading operational risk in European skies.[1]

The *Airspace Infringement Action Plan*[2] prescribes safety improvement recommendations and guidance for their implementation, scheduled to begin this year.

"Improving the safety of European airspace will require the collaborative effort of all parties concerned — national authorities, airspace user organizations, service providers and military," the action plan's "Statement of Commitment" says.

Alexander Krastev of Eurocontrol, coordinator of the Airspace Infringement Initiative, said that airspace infringements occur several times a day in busy European airspace. In a presentation to Flight Safety Foundation's 22nd annual European Aviation Safety Seminar in March 2010 in Lisbon, Portugal, he said that an analysis of reported infringements from 2002–2008 found a steady increase in the number of incidents per year and noted a 13.5 percent annual increase in 2009. The greatest year-to-year increase during the period was in 2005, with 30 percent more reported infringements than the previous year (Figure 1).

The action plan notes that the increasing number of reported events might have been influenced by growing awareness of the airspace infringement risk, as well as overall improvements in the reporting culture. However, some countries do not collect data on this type of safety-related event.

In recent years, the percentage of incidents with a "significant to serious safety impact" has been around 40 percent, the action plan says.

Consequences of an infringement event are classified in one of three ways:

- Disruption to flight operations, which results in a significantly increased pilot and/or controller workload, such as being forced to break off an approach to landing or change aircraft landing sequences;

- Loss of separation, which may result in a wake vortex encounter and subsequent loss of control, or in injuries to people in the airplane if abrupt maneuvers are required to avoid the other aircraft; and,
- Midair collision.

The unreliability of data has made it impossible to know exactly what proportion of the airspace infringement risk is associated with general aviation.

J.A. Donoghue

Who, Where and How?

Eurocontrol's analysis of infringement events reported in 2005 and 2006 shows that 56 percent of infringements involved GA aircraft on VFR flights, the action plan says. Commercial and military instrument flight rules (IFR) flights each were responsible for about 10 percent of total infringements.

"This is not a surprise, as most GA VFR flights are conducted outside controlled areas and zones and are in general flown by less trained and experienced leisure pilots, whereas IFR flights are usually contained within controlled airspace and carried out under the supervision of ATC [air traffic control] units," the action plan says.

Nevertheless, the document says that the unreliability of data has made it impossible to know exactly what proportion of the airspace infringement risk is associated with general aviation.

Terminal control areas were the most common sites of airspace infringement, the report says, noting that 40 percent of events occurred there, and 36 percent occurred in airport control zones (Figure 2, p. 42). In addition, most infringements occurred when aircraft were in level flight.

Although the action plan could identify no single factor as the major cause of airspace infringement, pilots' navigation skills "appear to play the most prominent role," the document says. A survey of European GA pilots conducted in 2007, during the information-gathering phase of the airspace infringement initiative, found that "although the level of navigation and communication skills acquired by student pilots during initial training raises some concerns, it is the apparent gradual diminishing of the skills of 'low-hours' pilots which requires consideration and adequate measures," the action plan says. "Refresher training is considered of particular importance by the vast majority of pilots interviewed."

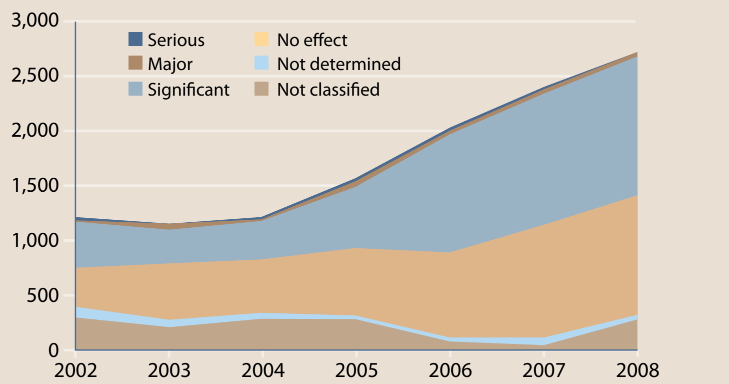
Fewer data were available on infringements involving commercial and military flights, but the data indicated that inadequate coordination between different control sectors might have been a factor, the action plan says.

Responsible Factors

Krastev said in his presentation that several major factors are responsible for many airspace infringement events, including differences from one country to the next in the upper limits of uncontrolled airspace; differences in the levels of services that individual European countries provide to pilots of VFR aircraft; and the diversity of GA operations.

"The range is enormous, from taxi and corporate business jet flights, through aerial work

Number of Infringements

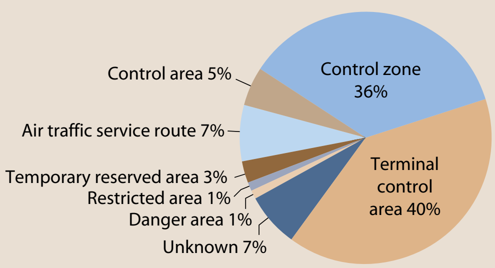


Note: A *serious* incident is defined by Eurocontrol and the International Civil Aviation Organization as one "involving circumstances indicating that an accident nearly occurred." A *major* incident is one "in which safety of aircraft may have been compromised, having led to a near collision between aircraft, with ground or obstacles." A *significant* incident involves "circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins or if another aircraft had been in the vicinity."

Source: Eurocontrol

Figure 1

Where Infringements Occur



Source: Eurocontrol

Figure 2

and powered leisure flights to flying all kinds of non-powered airplanes, balloons and paragliders," Krastev said. "Respectively, the regulatory frameworks differ significantly, ranging from very strict for multi-engine aircraft flying to practically non-existent [for] paragliding."

Eurocontrol's response has been the development of the action plan, which was prepared over a four-year period, with input from all sectors of the European aviation community. The action plan "aims to achieve the right balance between positive encouragement and regulatory enforcement, which is of particular importance for the development of general aviation in Europe," the action plan's "Statement of Commitment" says. "It is a further acknowledgement of the recognized need for harmonization and standardization of the services provided to all flights in European airspace, and calls for a consistent and integrated approach to the needs of general aviation, military and commercial operations."

Recommendations

The action plan includes recommended actions and proposed actions[3] for seven groups: airspace users, providers of aeronautical information services and meteorological services, air navigation service providers, military organizations, training organizations, regulatory authorities and Eurocontrol.

Recommended actions for Eurocontrol call for the immediate publication of safety awareness information. By January 2011, a tool kit should have been developed to support the action plan, Eurocontrol should be providing support for enhancement of airspace infringement occurrence reporting, and the agency should have assessed the feasibility of establishing a single Web portal for European aeronautical information, the action plan says.

Other recommendations, to be implemented by 2012 or 2013, include calls for Eurocontrol to support the harmonization of lower airspace classification, flight information services and the development of European standards for VFR publications, as well as the development of "an overall concept for the carriage and operation of transponders by light aircraft."

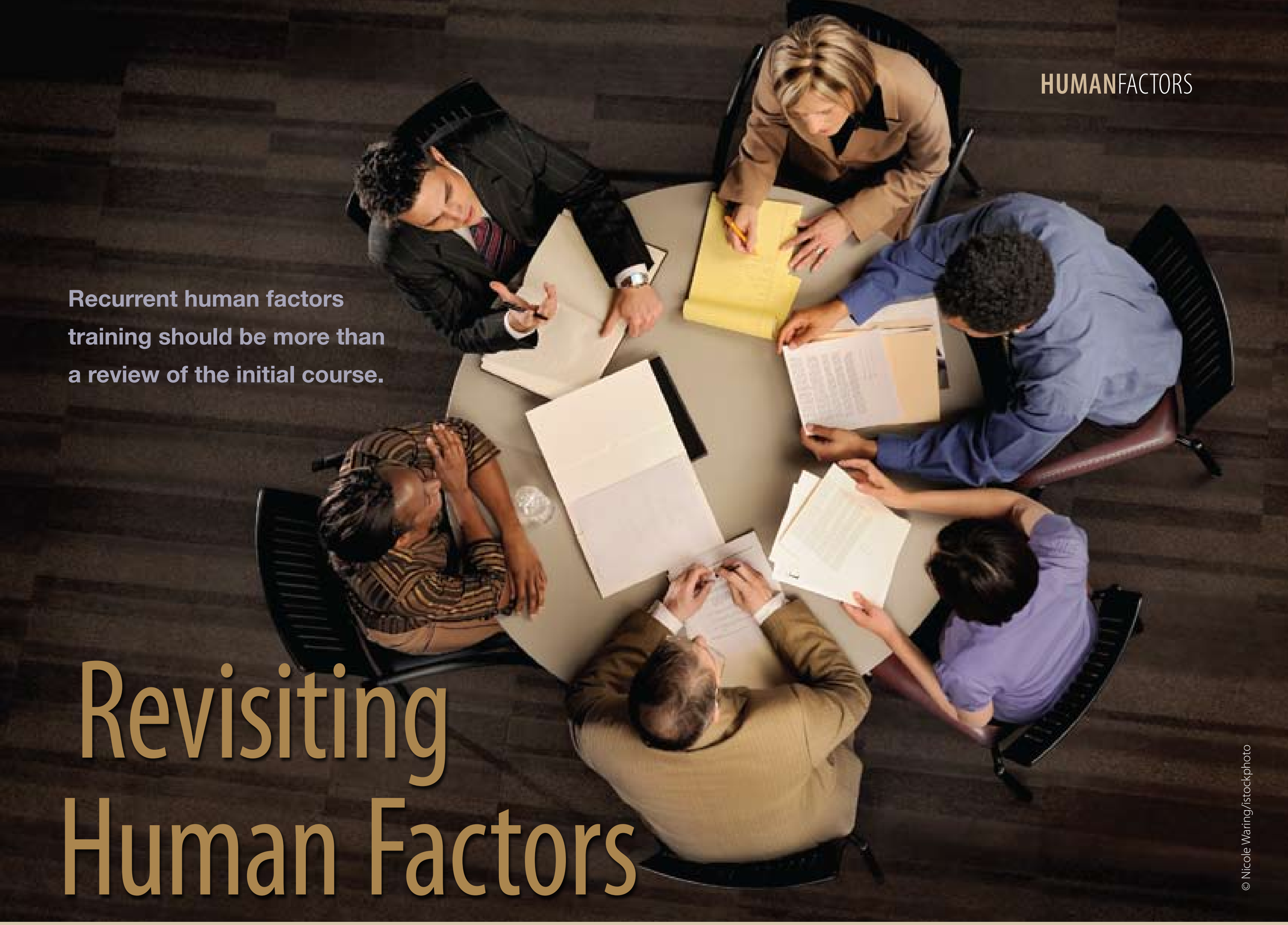
Similar harmonization recommendations were among those issued to national civil aviation authorities; other recommended actions called for a review of airspace infringement risk dimensions and establishment of national safety improvement priorities.

Recommended actions for airspace users call for improved awareness of the risk of airspace infringement, and regular updates of global positioning system databases by owners and operators of GA aircraft. Proposed actions for that group include implementation of periodic refresher training for GA pilots and using "better (advanced) equipment to improve navigation accuracy and integrity."

Other recommended actions call for air navigation service providers to improve communication skills and discipline for air traffic controllers and flight information center personnel, to review and simplify the boundaries of the controlled airspace structure and to organize periodic meetings between controllers and local GA pilots.

Notes

1. The Eurocontrol Safety Regulation Commission has identified four major risk areas in European airspace. In addition to airspace infringement, the others are controlled flight into terrain, runway incursion and level bust (deviation from an assigned altitude or flight level).
2. Eurocontrol. *European Action Plan for Airspace Infringement Risk Reduction.* January 2010.
3. "Recommended" actions are characterized as those that are "consistently considered of key or high importance with respect to their potential to improve safety" and that should be implemented. "Proposed" actions are "consistently considered of high or medium importance," and their implementation should be considered, the action plan says.



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Recurrent human factors training should be more than a review of the initial course.

Revisiting Human Factors

BY ROBERT BARON

Recurrent training has long been a standard process in aviation, an attempt to make sure that skills once learned are retained and can be easily recalled when needed. In human factors (HF), however, recurrent training raises more issues than the relatively straightforward initial training.

The subject matter that should be covered in a recurrent course is not always obvious. Also, organizations may have trouble setting outcome objectives, which measure the effectiveness of the training and help shape or revise future courses. However, we can consult a pair of popular learning models.

Bloom's taxonomy[1] depicts six levels of cognitive activation in the learning process. They range from the lowest level, *knowledge*, to the highest level, *evaluation*, with levels in between that are increasingly more complex and abstract (Figure 1, p. 44, and Table 1, p. 44).

Another theory, called the Kirkpatrick model,[2] uses four levels, each evaluating a specific type of learning that has occurred. These range from the lowest level, *reactions* to the course, to the highest level, *results*, with the intermediate levels measuring *learning* and *transfer* (Figure 2, p. 45, and Table 2, p. 45).

In terms of Bloom's taxonomy, HF initial courses typically are taught at the lowest two levels, knowledge and comprehension. In the Kirkpatrick model, most course objectives focus on the lowest levels, reactions and learning. After an HF initial course, the student should be able, for instance, to recite the "dirty dozen" (DD), a group of human factors identified in a Transport Canada workshop, that can degrade individual performance — for example, complacency and distraction. The student also should be able to suggest types of personal or organizational influences that can lead to errors according to the DD categories.

The Kirkpatrick model's reactions and learning domains are measured using course evaluation sheets. Testing can include pre- and post-testing, individual subject tests throughout the course, or perhaps one final exam. Testing is an efficient way to find out what the students learned and if the training objectives have been met.

Recurrent HF courses should reach into higher levels of Bloom's taxonomy, not simply recycle the initial course. The recurrent course is the perfect opportunity for students to work more abstractly with human factors topics.

The topics should be approached and discussed at the higher levels of Bloom's taxonomy. The recurrent course is also ideal for discussing company-specific accidents and incidents.

Since the HF initial course, the student most likely has been able to apply his or her knowledge to error prevention strategies on the job. These strategies should now become part of the overall learning experience as students share anecdotes and information with the rest of the class.

Case studies and video re-enactments are useful in analysis. At this level, students should be able to thoroughly dissect the case study, employ logical deduction, and fully understand the accident chain and its implications.

Many students can relate to occurrences that happen in their "own backyard," as opposed to generic material in the initial course. When used as case studies, company-specific occurrences should focus on "why," not "who." As synthesis, students should be able not only to dissect the occurrence but also to recommend procedures to prevent recurrence. These mitigations may be policies, procedures and task cards, new or revised.

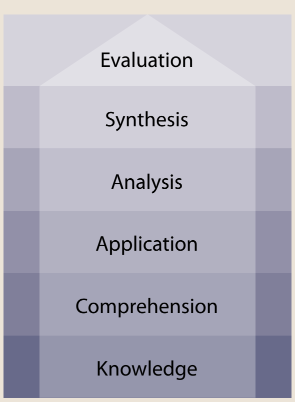
At the highest level of Bloom's taxonomy, the student should be able to critically evaluate, compare and contrast error prevention strategies. Comparisons can be made among various error prevention methodologies. Methodologies that appear to be working can be retained, with others revised or updated.

In terms of Kirkpatrick's highest level — results — the HF recurrent course is ideal for discussing the impact of learning on the organization. In this case, the HF facilitator might want to show the class the "big picture." How has the HF training affected the rates of accidents, incidents, errors, violations, occurrences and injuries? Is the trend moving in the right direction? If so, reinforcement of current practices may suffice. If not, why not? What can be done better?

If there is a problem with the organization, it should concern upper management. Unless upper management is represented in the class, a meeting with this group is in order. A successful HF training program — including recurrent training — that contributes to a reduction in accidents, incidents and injuries more than pays for itself. Even if the accident, incident and injury rates are steady or increasing, the training is not necessarily a failure; the trend might be worse without it.

The ideal recurrent course should focus more on abstract concepts and ideas than the initial course, including the safety "hot spots" in the organization and the aviation industry.

Bloom's Taxonomy



Source: Robert Baron, after Benjamin Bloom

Figure 1

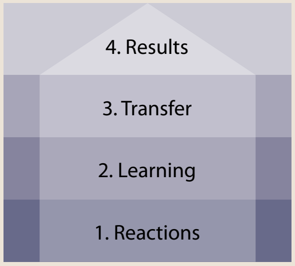
Bloom's Taxonomy Level Examples

Level	Examples
Evaluation Makes judgments about ideas or materials.	The student can evaluate, compare and contrast error prevention strategies.
Synthesis Builds a structure or pattern from diverse elements. Puts parts together to form a whole, with emphasis on creating a new meaning or structure.	The student can write new policies, procedures, task cards, etc. to reduce errors.
Analysis Separates material or concepts into components. Distinguishes between facts and inferences.	The student can diagnose an error by logical deduction.
Application Uses a concept in a new situation. Applies what was learned in the classroom to the job.	The student can apply error prevention strategies to the job.
Comprehension Understands the meaning of instructions and problems.	The student can explain the types of errors.
Knowledge Recalls information.	The student can recall the types of errors.

Source: Robert Baron, after Benjamin Bloom

Table 1

Kirkpatrick Model



Source: Robert Baron, after Donald Kirkpatrick

Figure 2

Kirkpatrick Model Level Examples

Level	Examples
Results The impact that learning has on the organization as a whole	Positive return on investment. Fewer accidents, incidents, errors, violations, occurrences, injuries, etc.
Transfer The transfer of what has been learned to the practical environment and the resultant change in behavior	Modification of behavior to mitigate and diminish errors (e.g., double checks to make sure no tools were left in the aircraft)
Learning The degree to which learning occurs as a result of the course	Testing at the conclusion of the course
Reactions A trainee's reaction to the course	Course evaluation sheets

Source: Robert Baron, after Donald Kirkpatrick

Table 2

Students should be able to explain the review topics in detail to the facilitator, rather than the other way around as with an initial course. New ideas and concepts should be introduced. The preferred delivery method for "soft skill" courses, such as HF, is face-to-face. Computer-based training is useful for technical subjects but not necessarily best where a high level of interaction between the facilitator and students is needed.

A recommended course outline for an HF recurrent course might look like this, in the suggested order:

Review of the dirty dozen. Presented creatively, the DD is an important anchor point for a review, since most errors occur because of one or more of the DD factors. Students already should be familiar with all 12 factors and be able to give examples of each, as well as what types of countermeasures they have used to trap an error. Each DD factor should be presented individually, with open discussion encouraged.

Review of the SHELL model. The SHELL model allows students to easily visualize the interface between the person, or *liveware*, and all of the peripheral error influences — software, hardware, environment and other liveware. Spend some time on this, because the SHELL model may be referred to throughout the course.

Generic case studies. The case studies may be delivered in a video or reading format. Video is the best delivery method, but written studies also can make the points. Case studies in the recurrent course should go beyond simple explanations and exhortations. At this level, students should be able to dissect the case study and offer substantive feedback about all the links in the accident chain.

Company-specific human factors–related accidents and incidents. The recurrent course is a unique opportunity to present company-specific, human factors–related accidents and incidents. These accidents and incidents tend to have a high level of "sticking power" in memory because of personal association.

A review of the company's overall safety statistics. This material addresses the results level in the Kirkpatrick model. How has the learning affected the organization as a whole over time? Visuals such as bar charts and graphs are an ideal platform for presenting and discussing results. After presenting the data, the facilitator elicits open discussion. It is important for the facilitator to fully understand the results and be prepared to offer guidance for improvements. If the results indicate an encouraging downward trend in accidents, incidents and injuries, the facilitator also should be prepared to reinforce the positive results and encourage students to keep the trend moving in that direction.

Working at the higher levels in Bloom's taxonomy and the Kirkpatrick model will allow students to think in more abstract terms, increase their use of deductive logic, and fully understand the organization's commitment to human factors training and the corresponding error reduction.

Robert Baron, Ph.D., is the president and chief consultant of the Aviation Consulting Group. He is also an adjunct professor at Embry-Riddle Aeronautical University and Everglades University, and teaches courses on aviation safety and human factors.

Notes

1. The taxonomy was first presented in a 1956 book edited by Benjamin Bloom and is widely used in the educational field.
2. Donald Kirkpatrick's model was published in a 1975 book, *Evaluating Training Programs*.

Redefining V_A

BY MARK LACAGNINA

The FAA wants to clear up potentially dangerous misunderstandings about maneuvering speed.

Excessive rudder pedal inputs caused the vertical stabilizer to separate from an A300 during departure from New York in 2001.

Contrary to a common misconception among pilots, operating an airplane at or below its design maneuvering speed (V_A) provides only limited protection against structural damage, according to the U.S. Federal Aviation Administration (FAA), which has proposed that airplane flight manuals be revised to clarify that abrupt and/or full flight control inputs *can* cause something to break.

The rule-making action responds to a U.S. National Transportation Safety Board (NTSB) recommendation related to the crash of an Airbus A300 in New York on Nov. 12, 2001. NTSB found that the probable cause of the accident was "the in-flight separation of the vertical stabilizer as a result of the loads beyond ultimate design loads that were created by the first officer's unnecessary and excessive rudder pedal inputs."[1]

In a notice issued late last year, the FAA said the accident investigation revealed that "many pilots of transport category airplanes believe that as long as they are below the airplane's V_A, they can make any control input they desire without risking structural damage to the airplane."[2]

This is a false and potentially dangerous assumption, according to the FAA.

Understanding what V_A is — and is not — requires a basic knowledge of how it is used during airplane design and certification. The design maneuvering speed established by the manufacturer is a benchmark to gauge structural loads resulting from specific movements of the flight control surfaces and to determine how strong the airplane must be to withstand the loads.

The most important consideration is that the structural design criteria of U.S. Federal Aviation Regulations Part 25 "only consider a single full control input in any single axis," the FAA said. "The standards do not address full control inputs in more than one axis at the same time or multiple inputs in the same axis."

Flight 587

The A300 accident demonstrated that catastrophic structural damage can result from such control inputs. The first officer, the pilot flying, was known to have an exaggerated concern about wake turbulence and to overreact to wake encounters with excessive control inputs.

According to the NTSB report, the airplane, operated as American Airlines Flight 587, encountered mild wake turbulence from a preceding Boeing 747 while climbing through 2,430 ft at about 240 kt, or 30 kt below V_A. The A300 was in a 23-degree left bank, and the wake began to roll the airplane further left. The first officer abruptly applied right aileron/spoiler and full right rudder. The airplane responded by rapidly rolling and yawing right. Perceiving that these movements were caused by the wake turbulence, not by his control inputs, the first officer applied full left rudder and left aileron/spoiler. This was followed in the next few seconds by three more cyclic control inputs.

The control inputs induced sideslip angles that imposed extremely high aerodynamic loads on the vertical stabilizer, causing it to separate from the fuselage. The crippled airplane descended into a residential area, killing all 260 people aboard and five people on the ground.

Guidelines for Revision

Among the 15 NTSB recommendations generated by the accident investigation was that the FAA should "amend all relevant regulatory and advisory materials to clarify that operating at or below maneuvering speed does not provide structural protection against multiple full control inputs in one axis or full control inputs in more than one axis at the same time."

In response, the FAA has proposed guidelines to revise Part 25.1583, which currently requires that airplane flight manuals (AFMs) include the following statement about V_A: "Full application of rudder and aileron controls, as well as maneuvers that involve angles-of-attack near the stall, should be confined to speeds below this value."

Rather than specifying wording for a new statement, the agency said that it should be tailored to the particular airplane design while including explanations that "full application of pitch, roll or yaw controls should be confined to speeds below V_A" and that "rapid and large alternating control inputs, especially in combination with large changes in pitch, roll or yaw, and full control inputs in more than one axis at the same time should be avoided, as they may result in structural failures at any speed, including below V_A."

The FAA pointed out that inclusion of the terms "pitch, roll and yaw controls" accounts for other control surfaces that provide or augment control in any given axis.

The phrase "as well as maneuvers that involve angles-of-attack near the stall" would be eliminated. "The existing text assumes that, for high angle-of-attack maneuvers below V_A, the airplane will always stall before structural failure can occur," the FAA said. "However, this is not always the case."

The proposal applies only to new airplanes. The FAA noted that, at its request, manufacturers of "major transport category airplane types currently in service" have voluntarily revised their AFMs to include statements that conform to the proposed guidelines.

The agency received four formal responses to the proposal. NTSB and the Air Line Pilots Association, International (ALPA) expressed support. ALPA also urged the FAA to include "all airspeed restrictions related to aircraft design limitations" in the proposal and in pilot training programs. "For example, include information to clarify the operational difference between V_A and the rough air penetration speed, V_B," ALPA said.

In a response comprising two sentences, Airbus stated its understanding that the manufacturer will be authorized to select the wording for the AFM statement.

Several comments were filed by Geoffrey Barrance, a retired avionics systems safety engineer, who characterized the proposal as "weak" and said that it "does not address the problem facing a pilot in knowing at what speed a certain input to the airframe is safe and what type of input is likely to cause structural failure."

The FAA told *ASW* that these comments are being considered in the development of a "final rule package" that likely will be issued this year.

Notes

1. NTSB Aircraft Accident Report NTSB/AAR-04/04.
2. Docket no. FAA-2009-0810. *Federal Register* Volume 74 (Sept. 4, 2009).

BY RICK DARBY

Safety Improves in U.S. On-Demand Operations

Part 121 accident data presented a mixed picture in 2009.

Although the February 2009 fatal accident involving a Colgan Air Bombardier Q400[1] shook the confidence of the industry and the public, it was a relatively good year overall for U.S. civil aviation accident rates based on preliminary data, the U.S. National Transportation Safety Board (NTSB) says.[2]

The fatal accident rate for scheduled flights under U.S. Federal Aviation Regulations (FARs) Part 121 was 0.01 per 100,000 departures (Table 1). There were no fatal accidents in FARs Part 135 commuter operations.

The 2009 rate for all accidents in Part 121 scheduled operations, 0.26 per 100,000 departures, was higher than the 0.19 for 2008. Nonscheduled Part 121 flights had a rate per 100,000 departures of 2.66 in 2009, compared with 4.83 in 2008. The 26 Part 121 accidents in scheduled service exceeded the 20 in 2008.

Accidents, Fatalities and Rates, U.S. Civil Aviation, 2009

	Accidents		Fatalities		Accidents per 100,000 Flight Hours		Accidents per 100,000 Departures	
	All	Fatal	Total	Aboard	All	Fatal	All	Fatal
U.S. air carriers operating under FARs Part 121								
Scheduled	26	1	50	49	0.149	0.006	0.255	0.010
Nonscheduled	4	1	2	2	0.753	0.188	2.663	0.666
U.S. air carriers operating under FARs Part 135								
Commuter	2	0	0	0	0.685	—	0.353	—
On-demand	47	2	17	14	1.63	0.07	—	—
U.S. general aviation	1,474	272	474	465	7.20	1.33	—	—
U.S. civil aviation	1,551	275	534	530	—	—	—	—
Non-U.S.-registered	7	2	2	2	—	—	—	—

FARs = U.S. Federal Aviation Regulations

Notes: All data are preliminary.

Flight hours and departures are compiled and estimated by the U.S. Federal Aviation Administration (FAA). On-demand U.S. Federal Aviation Regulations (FARs) Part 135 flight hours are estimated by the FAA. Departure information for on-demand Part 135 operations is not available.

Accidents and fatalities in the categories do not necessarily sum to the figures in U.S. civil aviation because of collisions involving aircraft in different categories.

U.S. air carriers operating under Part 135 previously referred to as scheduled and nonscheduled services are now called commuter operations and on-demand operations respectively. On-demand Part 135 operations encompass charters, air taxis, air tours, or medical services when a patient is on board.

Source: U.S. National Transportation Safety Board

Table 1

Accidents and Accident Rates, FARs Part 121, by NTSB Classification, 2000–2009

	Accidents				Accidents per Million Hours Flown			
Year	Major	Serious	Injury	Damage	Major	Serious	Injury	Damage
2000	3	3	20	30	0.109	0.109	1.093	1.475
2001	5	1	19	21	0.281	0.056	1.067	1.179
2002	1	1	14	25	0.058	0.058	0.810	1.446
2003	2	3	24	25	0.114	0.172	1.374	1.431
2004	4	0	15	11	0.212	0.000	0.794	0.583
2005	2	3	11	24	0.103	0.155	0.567	1.238
2006	2	2	7	22	0.104	0.104	0.363	1.142
2007	0	2	14	12	0.000	0.102	0.713	0.611
2008	3	1	8	16	0.157	0.052	0.419	0.838
2009	2	3	15	10	0.111	0.167	0.833	0.556

FARs = U.S. Federal Aviation Regulations; NTSB = U.S. National Transportation Safety Board

Notes: The NTSB classifications are as follows:

Major — an accident in which any of three conditions is met: A Part 121 aircraft was destroyed, or there were multiple fatalities, or there was one fatality and a Part 121 aircraft was substantially damaged.

Serious — an accident in which at least one of two conditions is met: There was one fatality without substantial damage to a Part 121 aircraft, or there was at least one serious injury and a Part 121 aircraft was substantially damaged.

Injury — a nonfatal accident with at least one serious injury and without substantial damage to a Part 121 aircraft.

Damage — an accident in which no person was killed or seriously injured, but in which any aircraft was substantially damaged.

Source: U.S. National Transportation Safety Board

Table 2

Passenger Injuries and Injury Rates, FARs Part 121 Scheduled Service, 2000–2009

	Accidents		Fatalities		Accidents per 100,000 Flight Hours		Accidents per 1,000,000 Miles Flown		Accidents per 100,000 Departures	
Year	All	Fatal	Total	Aboard	All	Fatal	All	Fatal	All	Fatal
2000	49	2	89	89	0.280	0.011	0.0069	0.0003	0.443	0.018
2001	41	6	531	525	0.216	0.012	0.0053	0.0003	0.348	0.019
2002	34	0	0	0	0.203	—	0.0049	—	0.331	—
2003	51	2	22	21	0.302	0.012	0.0073	0.0003	0.499	0.020
2004	23	1	13	13	0.126	0.005	0.0030	0.0001	0.213	0.009
2005	34	3	22	20	0.182	0.016	0.0043	0.0004	0.312	0.027
2006	26	2	50	49	0.139	0.011	0.0033	0.0003	0.245	0.019
2007	26	0	0	0	0.137	—	0.0032	—	0.242	—
2008	20	0	0	0	0.108	—	0.0026	—	0.195	—
2009	26	1	50	49	0.149	0.006	0.0036	0.0001	0.255	0.010

FARs = U.S. Federal Aviation Regulations

Notes: 2009 data are preliminary.

Flight hours, miles and departures are compiled by the U.S. Federal Aviation Administration.

For 2001, the Sept. 11 terrorist attack is included in the totals for accidents and fatalities but excluded for accident rate computation. Other than the persons aboard aircraft who were killed, fatalities resulting from the act are excluded.

Source: U.S. National Transportation Safety Board

Table 3

Among all Part 121 accidents, two were classified by the NTSB as major (Table 2).[3] That was a decrease from three in 2008 and from the average for the preceding nine years, beginning in 2000, of 2.4.[4] The number of accidents classified as serious and as injury accidents increased from 2008.

The 2009 rate for Part 121 major accidents per 100,000 departures was 0.11, compared with 0.16 in 2008 and an average of 0.13 for the nine years of 2000 to 2008. Rates for serious and injury accidents increased in 2009 over those for 2008.

Despite the Colgan Air accident, the 2009 fatal accident rate for Part 121 scheduled operations, 0.01, equaled the previous nine-year average (Table 3). The latest rate for all accidents in Part 121 scheduled operations, 0.26, is below the previous nine-year average of 0.31.

Excluding the 2001 fatal accident total, which included the Sept. 11 hijacked airplanes as

Accidents, Fatalities and Rates, FARs Part 121, Nonscheduled Service, 2000–2009

	Accidents		Fatalities		Accidents per 100,000 Flight Hours		Accidents per 1,000,000 Miles Flown		Accidents per 100,000 Departures	
Year	All	Fatal	Total	Aboard	All	Fatal	All	Fatal	All	Fatal
2000	7	1	3	3	0.853	0.122	0.0188	0.0027	1.689	0.241
2001	5	0	0	0	0.762	—	0.0167	—	1.533	—
2002	7	0	0	0	1.225	—	0.0265	—	3.012	—
2003	3	0	0	0	0.517	—	0.0113	—	1.462	—
2004	7	1	1	1	1.002	0.143	0.0215	0.0031	2.915	0.416
2005	6	0	0	0	0.885	—	0.0186	—	2.728	—
2006	7	0	0	0	1.138	—	0.0243	—	3.619	—
2007	2	1	1	1	0.321	0.161	0.0069	0.0034	1.030	0.515
2008	8	2	3	1	1.464	0.366	0.0325	0.0081	4.832	1.208
2009	4	1	2	2	0.753	0.188	0.0166	0.0041	2.663	0.666

FARs = U.S. Federal Aviation Regulations

Notes: 2009 data are preliminary.

Flight hours, miles and departures are compiled by the Federal Aviation Administration.

Source: U.S. National Transportation Safety Board

Table 4

Accidents, Fatalities and Rates, FARs Part 135, Commuter Operations, 2000–2009

	Accidents		Fatalities		Accidents per 100,000 Flight Hours		Accidents per 1,000,000 Miles Flown		Accidents per 100,000 Departures	
Year	All	Fatal	Total	Aboard	All	Fatal	All	Fatal	All	Fatal
2000	12	1	5	5	3.247	0.271	0.2670	0.0223	1.988	0.166
2001	7	2	13	13	2.330	0.666	0.1624	0.0464	1.254	0.358
2002	7	0	0	0	2.559	—	0.1681	—	1.363	—
2003	2	1	2	2	0.627	0.313	0.0422	0.0211	0.349	0.175
2004	4	0	0	0	1.324	—	0.0855	—	0.743	—
2005	6	0	0	0	2.002	—	0.1312	—	1.138	—
2006	3	1	2	2	0.995	0.332	0.0645	0.0215	0.528	0.176
2007	3	0	0	0	1.028	—	0.0651	—	0.506	—
2008	7	0	0	0	2.385	—	0.1508	—	1.215	—
2009	2	0	0	0	0.685	—	0.0432	—	0.353	—

FARs = U.S. Federal Aviation Regulations

Notes: 2009 data are preliminary. Flight hours, miles, and departures are compiled by the U.S. Federal Aviation Administration (FAA).

Based on a February 2002 FAA legal interpretation provided to the NTSB, any Part 135 operation conducted with no revenue passengers aboard is be considered an on-demand flight operation. This interpretation is applied to accidents beginning with the year 2002.It has not been retroactively applied to accidents in 2000 and 2001.

U.S. air carriers operating under Part 135 previously referred to as scheduled and nonscheduled services are now called commuter operations and on-demand operations respectively. On-demand Part 135 operations encompass charters, air taxis, air tours, or medical services when a patient is on board.

Source: U.S. National Transportation Safety Board

Table 5

Accidents, Fatalities and Rates, FARs Part 135, On-Demand Operations, 2000–2009

	Accidents		Fatalities		Accidents per 100,000 Flight Hours	
Year	All	Fatal	Total	Aboard	All	Fatal
2000	80	22	71	69	2.04	0.56
2001	72	18	60	59	2.40	0.60
2002	60	18	35	35	2.06	0.62
2003	73	18	42	40	2.49	0.61
2004	66	23	64	63	2.04	0.71
2005	65	11	18	16	1.70	0.29
2006	52	10	16	16	1.39	0.27
2007	62	14	43	43	1.54	0.35
2008	58	20	69	69	1.81	0.62
2009	47	2	17	14	1.63	0.07

FARs = U.S. Federal Aviation Regulations

Notes: 2009 data are preliminary.

Flight hours are estimated by the U.S. Federal Aviation Administration (FAA).

In 2002, FAA changed its estimate of on-demand activity. The revision was retroactively applied to the years 1992 to 2002. In 2003, the FAA again revised flight activity estimates for 1999 to 2002.

U.S. air carriers operating under Part 135 previously referred to as scheduled and nonscheduled services are now called commuter operations and on-demand operations respectively. On-demand Part 135 operations encompass charters, air taxis, air tours, or medical services when a patient is on board.

Source: U.S. National Transportation Safety Board

Table 6

accidents, the previous nine years averaged 1.33 fatal accidents in the category, higher than the one fatal accident in 2009. The category included 26 total accidents in 2009, compared with the previous nine-year average — again factoring out 2001 — of 33.

Considering the 2009 fatal accident rate for Part 121 nonscheduled operations against the rest of the decade, it was the fifth lowest (Table 4). The rate, 0.67 per 100,000 departures, can be measured against a previous nine-year average of 0.26. It was, however, lower than the 2008 rate.

For Part 135 commuter operations, the 2009 total accident rate of 0.35 per 100,000 departures was encouraging in a year-over-year comparison with the 2008 rate of 1.22 and the nine-year average of 1.00 (Table 5).

There were two accidents in the category in 2009, also an improvement over the previous year's seven and the nine-year average of 5.67.

The Part 135 on-demand operations record for 2009 also showed an improvement in fatal accidents (Table 6). The rate, 0.07 per 100,000 flight hours — data for departures were unavailable — was about a tenth of the 2008 rate, and was by a comfortable margin the lowest in the 10-year period. The average rate for the previous nine years was 0.51.

The category's rate for all accidents, 1.63 per 100,000 flight hours, also was the third-lowest in the 10-year period, and better than the preceding nine-year average of 1.94.

Fatal accidents in the Part 135 on-demand category numbered two in 2009, compared with 20 in 2008. Again, the number was below that of any year in the previous nine, which averaged 17.11. Total accidents were also fewer than any other year in the 10-year period, as were on-board fatalities.

Notes

1. The Colgan Air flight, operating as Continental Connection 3407, crashed on approach to the Buffalo, New York, airport following a stall. There were 49 on-board fatalities and one ground fatality.

2. The NTSB data are available online at <www.ntsb.gov/aviation/Stats.htm>.

3. The NTSB classifications are as follows:

   Major — an accident in which any of three conditions is met: A Part 121 aircraft was destroyed, or there were multiple fatalities, or there was one fatality and a Part 121 aircraft was substantially damaged.

   Serious — an accident in which at least one of two conditions is met: There was one fatality without substantial damage to a Part 121 aircraft, or there was at least one serious injury and a Part 121 aircraft was substantially damaged.

   Injury — a nonfatal accident with at least one serious injury and without substantial damage to a Part 121 aircraft.

4. All averages in this article are means.

Ascent Into the Maelstrom

Pilots and researchers test fierce storms … and themselves.

VIDEO

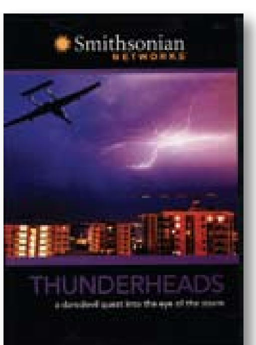
Extreme Meteorology

Thunderheads

Australian Broadcasting Corp. and Smithsonian Networks. DVD. Approximately 47 minutes. 2010.

Pilots normally go out of their way, literally, to avoid thunderstorms in flight. This video follows an experiment in which, for scientific research, a group of highly qualified pilots fly toward some of the largest thunderstorms the Earth has to offer. They go as close as possible to collect data while still — they hope — avoiding forces that could tear their aircraft apart.

The pilots bring with them specialized airplanes, designed for gathering weather information, from Australia, Germany, Russia, the United Kingdom and the United States. They, and scientists who control the flights and design the research, are part of the International Cloud Experiment (ICE). Their goal, the narrator says, is "to catch a cloud — but not just any cloud. They want to catch a thunderstorm."



And not just any thunderstorm. The experiment is based in Darwin, Australia, in the country's tropical north. Australia is a big country and it has big storms.

The region is known for mega-storms, collectively called "Hector." Hector can reach to twice the altitude of Mt. Everest.

Perhaps partly because Hector is a no-go area for other pilots — at least those who return safely — much remains unknown about their activity. "We are trying to track an ice cloud and see how it evolves," one of the ground-based researchers says.

Not even the project's experimental pilots and their airplanes of different types, modified for the ICE, dare to fly into the core of the thunderstorms. But they reach Hector's high-altitude periphery. One mission flies through an "anvil" — the horizontal top above the whirling air — that is 60 mi (97 km) long.

The experimental flights begin promisingly. But as might be expected considering the extreme conditions, danger is never far away. Two airplanes' airspeed indicators fail in flight on the same day, drastically increasing the pilots' task load and placing them in greater peril than they routinely face in the ICE. Delays ensue for repairs, which necessitate ordering new equipment. The project is behind schedule.

Once repairs and testing are complete, the flights resume. But time pressure mounts because of budgetary constraints. The frequency of flights must be increased.

The video camera and microphones record not only views inside and outside the cockpits at altitude, but also the discussions at the base between the pilots and the researchers in charge. Professionalism continues on all sides but the easy comradeship of the early days begins to fray at the edges. The scientists want to keep the pilots out of danger but have to reckon with the reality that the closer the approach to the thunderheads, the more valuable the data are likely to be.

Despite temporary setbacks and a few close calls, all is well in the end. The multi-national team has done its job successfully. Fortuitously, a cyclone develops and heads over land, its birth and development captured for the first time by the ICE team.

The video's production values are first-class. The narrator mentions several times the financial limitations the project is working under, and one has to wonder whether more resources were spent taping the experiment than performing it.

Dark pillows of cloud sag over the Darwin skyline. We see close-ups of Hector that few people will ever see, or want to see, in person. It must have been quite an undertaking to rig the cameras for the in-flight shots so they wouldn't be damaged or made inoperable by the expected turbulence. The time-lapse cinematography of the clouds' shape shifting is lovely, although perhaps overused, eventually coming to seem like filler.

The video will provide heady entertainment for aviation enthusiasts. The experiment it pictures will help scientists understand extreme meteorology.

— *Rick Darby*

WEB SITES

Human Factors, Maintenance Division

Aircraft Maintenance Human Factors Web Portal, <hfskyway.faa.gov/HFSkyway/index.aspx>

The Aircraft Maintenance (MX) Human Factors (HF) Web Portal has been evolving since 1995 and will continue to be refined to improve its usability and effectiveness, says the U.S. Federal Aviation Administration (FAA). The Web site is set up to give researchers direct access to the site, without entering the FAA's main Web site, thus the designation "portal."

The home page highlights several frequently requested manuals. One is "A Practical Guide to Maintenance ASAP Programs," published by the FAA in 2009, which defines a maintenance aviation safety action program or ASAP; outlines steps in developing an ASAP and measuring success; and discusses the relationships between maintenance ASAPs, just culture and safety management systems. The manual is the result of collaborative research by the FAA, St. Louis University, several airlines and repair stations, and other industry representatives.

Another popular manual is the FAA's "Operator's Manual: Human Factors in Airport Operations," available in English, Spanish and Chinese. Developed by the FAA at industry request, the manual reflects contributions from industry and government representatives in the United States and within Transport Canada, the U.K. Civil Aviation Authority, the European Aviation Safety Agency and the International Air Transport Association. The eight major topics addressed in the manual are procedural compliance; injury prevention; HF training; fatigue/alertness management; shift/task turnover; event investigation; auditing and assessment; and sustaining and justifying an airport operations HF program.

The MX HF presentation system, available online or in DVD format, is a "tool to help explain what human factors is, its value to the maintenance process and how it can be effectively applied in the maintenance environment," says the introduction. The presentation system includes videos accompanied by PowerPoint presentations, speaker notes, animations and other information. Multiple videos discuss HF, fatigue issues, sleep requirements, human error, and use of maintenance accidents and incidents to improve safety. Computer system requirements and instructions are available online, as is information for ordering the DVD.

Links and drop-down menus lead to more information. For example, tucked under the MX research projects tab is information on personnel management and fatigue. There are links to educational calendars and posters designed to bring awareness of human fatigue in aviation maintenance. Free downloads (in high resolution PDF format) may be printed and displayed in work and rest areas to help maintenance personnel change their lifestyle and work habits to improve safety and quality of life. Likewise, current and past issues of the quarterly newsletter, *MX Fatigue*

Focus, written for technicians and managers by a multi-disciplinary maintenance fatigue workgroup, can be found under the MX research tab.

Researchers can walk through the MX HF library menu or use its search engine to locate articles, presentations, reports, regulations and other documents with titles such as, "Use of Computer-Based Training to Improve Aircraft Inspection Performance," "The Current Picture of Rest Among Aviation Maintenance Technicians in Airline Environments" and "Shift Management: The Role of Fatigue in Human Error." Documents have been collected from Australia, Canada, the United Kingdom, the United States and other international sources. The conference materials section and the MX FAA section of the library contain HF and fatigue presentations delivered by FAA staff at various industry conferences, symposiums, meetings and workshops. Materials are free online and may be printed or downloaded.

LaserPointerSafety.com is a gold mine of laser safety information specific to aviation and tailored to pilots and laser pointer users.

Much information on fatigue and HF is already on the Web site, and many more topics are identified as *under development* or *coming soon*. Repeat visits to the Web site may yield new data and ideas.

— *Patricia Setze*

Laser Points to Remember

LaserPointerSafety.com,
<www.laserpointersafety.com/index.html>

The Web site of the International Laser Display Association (ILDA), <www.laserist.org/index.htm>, a membership organization, says that it "is the world's leading organization dedicated to advancing the use of laser displays in the fields of art, entertainment and education." In addition to the ILDA site, which has a considerable amount of free information about laser shows, laser graphics, atmospheric laser effects and safety, ILDA co-sponsors another Web site devoted to aviation safety — LaserPointerSafety.com.

ILDA says that it "is providing some resources for [LaserPointerSafety.com] as a public service. One reason is that, if the general public sees pointers as dangerous, this could have a negative impact on laser show productions." The LaserPointerSafety.com home page says in bold

letters, "Use laser pointers safely — don't get them banned."

LaserPointerSafety.com can be accessed directly or from the ILDA Web site. At either location, researchers can view or download at no charge two presentations from the ILDA 2009 conference — the 17-page report "Lasers and Aviation Safety" and its accompanying PowerPoint presentation with 68 slides. The report and slides discuss and illustrate hazards to pilots and ways to reduce them, a U.S. Federal Aviation Administration (FAA) study, FAA regulations, laser-related incidents and more.

LaserPointerSafety.com is a gold mine of laser safety information specific to aviation and tailored to pilots and laser pointer users. This site is a collection of reports, news stories, questions and answers, recommendations and articles about laser pointer use and eye safety. There is also a long list of downloadable files and documents, such as these two full-text reports: a 2009 study comparing the effects of searchlights and lasers, and a 2004 FAA simulator study of aircraft that were targeted by laser beams on short final approaches.

Most articles and reports are full text and free online. Many contain photographs, graphics and references. Some contain videos and simulations. The news section contains international articles from 2003 to the present. Entries are aggregated by categories, such as aircraft incidents, arrests or a country or organization name.

The safety site contains information on U.S. and non-U.S. laws and regulations related to laser pointers. The page is not intended to be all inclusive and says, "This list is intended to provide a starting point for additional research and to illustrate how legislators attempt to define various terms and regulate various actions."

— *Patricia Setze*

REPORTS

SMS Basics

Twelve Steps to an Effective Safety Management System: A Review of the Fundamentals

National Business Aviation Association (NBAA). 5 pp. Winter 2010. Available via the Internet at <links.mkt779.com/ctt?kn=19&m=4343794&r=NTMzNTExOTk4MwS2&b=0&j=MTU2NTExNjgxS0&mt=2&rj=MTU2NDgyMDk0S0&rt=0>.

Business aviation accident rates have "fallen dramatically over the past several decades due in large part to embracing new technologies like simulator training, [enhanced ground proximity warning system] and [terrain awareness and warning system], and by improved crew resource management techniques," this "white paper" from NBAA says.

The rate of improvement has leveled off recently, and one of the next frontiers in risk management is reducing "organizational deficiencies," the paper says. But "business aviation can prevent many of the current accidents and mishaps through the development of a 'safety culture' that emphasizes a systematic approach to identifying and minimizing hazards — a safety management system (SMS)."

The paper's purpose is to "describe the basic steps necessary to develop a comprehensive and effective SMS. It is based on real-world experiences and best practices in business aviation."

NBAA advises, as a first step, becoming familiar with the concepts and philosophy underlying SMS. "Visit <www.nbaa.org/admin/sms> to get more background information and learn about successful SMS programs at other flight departments," the paper says.

Some of the further steps, and excerpts from their descriptions, include the following:

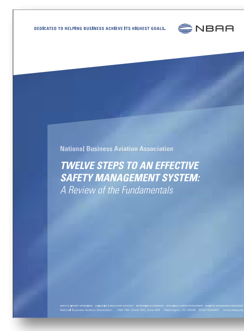
Obtain senior management commitment. "Securing senior management support for SMS early in the program should help to resolve more challenging questions about resources and priorities."

Establish an SMS team. "Involve every member of the flight department, as well as company passengers, customers and other lines of business. Wide participation in the formulation of the program not only increases employee buy-in, it also enhances the quality of the program."

Determine what resources you have and what you need. "The level of resources available to you — both internal and external — will dictate your SMS implementation timeline."

Conduct hazard identification and risk assessment, and develop a safety risk profile. "By producing an overview of the risks generally experienced by your flight operation (e.g., possible exposure to an accident, incident or regulatory violation), you can ensure that risk mitigation strategies are targeted in such a way as to optimize safety."

Identify safety accountabilities. "Defining precisely who is responsible for delivering specific goals is an important step to ensure that your SMS functions properly. It's not a 'blame game.' It's also not just another job for the 'safety guy' or 'safety gal.'"



Amend existing safety programs, procedures and documents as required. "As you make changes, make sure that the linkages are maintained and that everything operates as a system. Document your new plan and ensure everyone understands any changes made."

Conduct staff training and education. "Initial instruction and regular recurrent training are keys to ensuring that personnel are properly prepared for any likely contingency."

Track and evaluate safety management activities. "The only way to know if you are improving is to measure and periodically evaluate your performance. … Be sure to keep senior management engaged in the SMS evaluation processes."

The paper concludes, "Registration of your flight department under the International Standard for Business Aircraft Operations (IS-BAO) is the ultimate SMS solution."

— *Rick Darby*

Slippery Surprise

The flight crew learned on final approach that the runway was covered with snow.

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

Skidding Helped Prevent an Excursion

Airbus A321. Minor damage. No injuries.

The A321 was en route on a charter flight from Tenerife, Spain, to Sandefjord, Norway, with 216 passengers and seven crewmembers the afternoon of March 26, 2006. Weather conditions at the destination were forecast to include 4,000 m (2 1/2 mi) visibility in snow, with temporary conditions of 1,200 m (3/4 mi) visibility and 800 ft vertical visibility.

"Based on the received information, the flight crew did not expect any problems related to the weather or runway conditions," said a report on the serious incident issued by the Accident Investigation Board of Norway (AIBN) in March 2010. "They expected the runway to be prepared to the usual acceptable standard during winter operations."

The aircraft was about 40 minutes from the airport when snow began to accumulate on Runway 18, which was being used for landings and takeoffs. The runway had an available landing distance of 2,569 m (8,429 ft) and was 45 m (148 ft) wide.

"The airport supervisor had planned to sweep the runway," the report said. "This was postponed due to a technical problem with a sweeper and frequent departures and landings. … It was decided to carry out a friction measurement instead."

Friction measurements were made in one direction and on one side of the runway but could not be completed in the opposite direction on the other side of the runway because of traffic. Airport personnel decided to begin clearing the snow off the runway after the A321 landed.

During descent, the flight crew received data from the automatic terminal information service indicating that Runway 18 was dry and that braking action was "good." Reported visibility was 2,500 m (about 1 1/2 mi) in light snow, and the ceiling was at 500 ft. Winds were from 030 degrees at 6 kt.

The crew briefed for the instrument landing system (ILS) approach with the autopilot and autothrottles engaged. The on-board flight management system computed an approach speed of 142 kt, or 5 kt higher than the reference landing speed (V_{REF}). The crew added 5 kt to that value for expected icing conditions. The A321 entered the clouds shortly after descending through 10,000 ft.

When the crew established radio communication with the airport control tower three minutes before touchdown, they were told that Runway 18 was contaminated by 8 mm (about 3/8 in) of wet snow and that measured friction coefficients were 32 in the touchdown area of the runway, 33 in the middle and 31 at the end, indicating "medium" braking action.

The report said that the reported depth of snow was accurate for dry snow but, according to Norwegian runway condition reporting requirements, should have been increased by 4 mm (about 3/16 in), to 12 mm (about 1/2 in) because the snow was wet.

"This was the first time the crew became aware that the runway was contaminated by snow," the report said. "This, however, did not alarm them. With 'medium' braking action, there should be no problem coming to a halt on the runway available."

A post-incident analysis of weather and runway conditions, however, indicated that braking action actually was "poor," the report said.

While reconsidering the A321's landing performance, the commander asked for a wind check and was told by the tower controller that the surface wind was from 050 degrees at 5 kt. "This would give approximately a 4-kt crosswind and 3-kt tail wind, which was well within the company's limitations," the report said.

The first officer was the pilot flying. Recorded flight data showed that the approach was stabilized until the aircraft reached a radio altitude of 250 ft and began to deviate above the glideslope.

The commander called out the deviation, but the first officer was unable to correct it before the A321 crossed the runway threshold. The aircraft was one dot high on the glideslope at 50 ft and touched down about 780 m (2,559 ft) from the runway threshold at 140 kt. This was about 350 m (1,148 ft) beyond the intended touchdown point, the report said.

The first officer applied maximum reverse thrust after the main landing gear touched down. However, the crew perceived no braking action and suspected that the autobrake system had failed. "The commander therefore pressed the switch to rearm the autobrake 'medium' system without any effect," the report said.

About eight seconds after touchdown, the first officer applied maximum manual wheel braking. "The crew did not feel any braking action from the first officer's manual braking, and the commander took control of the aircraft halfway down the runway," the report said.

With about 800 m (2,625 ft) of runway remaining, the commander engaged the parking brake. "By then, the crew had realized that they would not be able to stop the aircraft on the runway," the report said.

The commander declared an emergency and told the tower controller that the aircraft was "going off the runway."

The first officer suggested that the commander steer left because the terrain off the left side of the runway appeared to be more level than the terrain off the right side of the runway.

When the commander steered left, the aircraft began to skid on its locked wheels toward the end of the runway. "This resulted in increased deceleration, and the aircraft stopped at the very end of the hard-surfaced runway, with the nosewheel against a concrete [localizer monitor] antenna base," the report said.

There were no injuries, and the A321 received minor damage to lower fuselage skin and to the nosewheel rim and tire. The crew shut down the engines, and the commander ordered a nonemergency evacuation through the left forward cabin door. Airport buses transported the passengers to the terminal.

"This incident is similar to several other [recent] runway excursions on slippery runways in Norway," the report said. It noted that the AIBN is preparing a special report on winter operations and runway friction measurements. "That report will highlight the common cause factors related to this type of incident. The report will specifically highlight safety areas of general nature which are outside the airline operators' direct area of responsibility."

An expected publication date for the special report was not provided.

'The crew realized that they would not be able to stop the aircraft on the runway.'

Controller Error Leads to Close Call

Boeing 767, McDonnell Douglas MD-82. No damage. No injuries.

Omission of a required clearance led to a near midair collision at Chicago O'Hare International Airport the afternoon of June 1, 2009. Visual meteorological conditions

(VMC) prevailed, with 10 mi (16 km) visibility and a 5,500-ft ceiling, said the report by the U.S. National Transportation Safety Board (NTSB).

The 767, inbound from Dublin, Ireland, with 202 passengers and five crewmembers, was on an extended, straight-in ILS approach to Runway 27L. The MD-82, inbound from St. Louis with 105 passengers and five crewmembers, was being vectored from a left downwind to the final approach course for Runway 28, which is south of Runway 27L.

The 767 flight crew was in radio communication with a Chicago Terminal Radar Approach Control (TRACON) Center Arrival controller. The MD-82 crew was in communication with a Chicago TRACON West Arrival controller and maintaining an assigned heading of 330 degrees.

Nearing the extended centerline of Runway 28, the MD-82 crew asked the West controller if they were cleared for a visual approach to Runway 28. The controller told the crew to turn left to a heading of 250 degrees and to descend to 2,500 ft. After the MD-82 crew acknowledged the instructions, the controller cleared the crew for a visual approach to Runway 28 and told them to establish radio communication with the airport traffic control tower.

'There was a good deal of congestion on the frequency.'

Shortly thereafter, the 767 crew told the Center controller, "We're going to be reacting to a Super 80," the name of the initial version of the MD-80 series.

The Center controller did not understand the transmission and asked, "Who was that again?"

The 767 crew identified their flight and said, "We got a Super 80 crossing our flight path right now on 27L."

"Roger," the Center controller said. "He's doing a visual to 28. Maintain visual separation with him but if you need to turn right, you can."

"We're going to have to," the 767 crew replied. "He's on our centerline." Shortly thereafter, the crew reported that the MD-82 was "clear."

The 767 captain told investigators that the first officer, the pilot flying, had called the "Super 80" as traffic. "With wings level on a northerly heading, I felt the S-80 might be lining up on our runway instead," the captain said. "With the S-80's nose still bore-sighted at us, at approximately 3,500 ft, I instructed the first officer to turn away to the right to give us some breathing room.

"About this time, we received an RA [resolution advisory] from the traffic [alert and] collision avoidance system to climb. The first officer stated he felt very uncomfortable to go belly-up to the S-80 but stopped his descent while jinking [turning] to the right. Roughly [at the same] altitude and a half mile away, the S-80 commenced a hard descending turn back to the south complex."

The MD-82 captain told investigators that the airplane was still on the assigned heading of 330 degrees as it neared the localizer course for Runway 28. "I directed the first officer to ask for an intercept turn and/or approach clearance. He was unable to do so immediately as there was a good deal of congestion on the frequency.

"He was able to query Approach as we were passing through the localizer on the previously assigned 330-degree heading. Approach responded with an immediate turn to 250 degrees and descent to 2,500 ft. As I began the turn and descent, we received an RA requiring an increased descent rate. I increased both the descent rate and bank angle, and the RA ceased."

The West controller said that he had told the MD-82 crew that another airplane was preceding them to Runway 28. The MD-82 crew said that they had the other airplane in sight. "Normal practice would have been to clear [the MD-82 crew] for the visual approach at that time, but the West Arrival controller did not do so," the report said. "He could not recall any specific distractions that may have caused him to omit the required clearance. He first realized that something may have gone wrong when [the MD-82 crew] asked if they were cleared for the visual approach."

The report said, "According to preliminary Federal Aviation Administration [FAA] data, lateral separation decreased to 0.35 nm [0.65 km] and vertical separation was 0 ft before the conflict was resolved. … There was no investigation of the event until the FAA received a complaint from the pilot of [the 767] two days after it occurred. The FAA's investigation revealed that the incident was [caused by] an operational error by air traffic control."

Pitot System Blocked by Ice

Raytheon 390 Premier. No damage. No injuries.

The flight crew was returning to Farnborough, England, after a charter flight to Copenhagen, Denmark, the afternoon of Aug. 7, 2008. The aircraft was cruising at Flight Level (FL) 400 (approximately 40,000 ft) with an outside air temperature of minus 62° C (minus 80° F) when it encountered severe turbulence.

"Although [the commander] did not consider the Premier to have a specific turbulence penetration speed, he reduced thrust in an attempt to decelerate and achieve a more comfortable ride," said the report by the U.K. Air Accidents Investigation Branch (AAIB). "He was surprised at the high rate at which the indicated airspeed [IAS] decreased."

The IAS on the no. 1, or commander's, primary flight display (PFD) decreased from 220 kt to 180 kt.

The crew requested and received clearance to climb to FL 410, where the air was slightly warmer and the aircraft was clear of clouds and turbulence. When normal cruise thrust was selected, the IAS on the no. 1 PFD slowly increased to 220 kt.

Shortly before reaching their planned beginning-of-descent point, the crew noticed a message on both PFDs indicating a discrepancy in airspeed indications. The no. 2 PFD and the standby airspeed indicator (ASI) indicated 220 kt; the no. 1 PFD indicated a lower and decreasing airspeed.

Believing that the no. 1 air data computer (ADC) had failed, the commander selected the no. 2 ADC to provide information to both PFDs. The IAS on the no. 1 PFD increased rapidly to the value indicated by the no. 2 PFD and the standby ASI.

However, the commander told investigators that during descent, the displayed airspeeds gradually decreased, as if the ASIs were acting like altimeters. When he repositioned the ADC switch to the normal setting, the no. 1 PFD indicated an overspeed, but the overspeed warning horn did not activate.

The commander reselected the no. 2 ADC for both PFDs, and the IAS on the no. 1 PFD again began to decrease. "IAS continued to reduce without activation of the stick shaker or aerodynamic buffet," the report said. "The commander recalled that at approximately 60 kt IAS, he heard a 'click' from the vicinity of the instrument panel, reminiscent of a relay operating."

Most of the information displayed on the PFDs disappeared, and the multifunction display (MFD) went blank. "The standby ASI indicated zero, but the standby altimeter, attitude and heading indicators appeared to function normally," the report said. "The commander used his experience of the aircraft to set thrust lever position and aircraft attitude appropriate to the phase of flight."

The copilot declared an emergency, and the crew diverted the flight toward Ostend, Belgium. After descending below the freezing level, 15,000 ft, however, a combined PFD and MFD display appeared on the MFD. The commander selected the normal ADC setting, and both PFDs returned to normal operation. The crew canceled the emergency and continued the flight to Farnborough without further incident.

The investigation determined that the IAS anomalies had been caused by moisture that entered and froze within the right pitot system. The loss of information from the PFDs and the MFD could not be replicated, "and the loss could not be explained," the report said.

TURBOPROPS

Direct Course to a Mountain

Pilatus Turbo Porter. Destroyed. Eleven fatalities.

The newly hired charter pilot likely had not received required route familiarization training and did not know that the 18-minute flight from Ilaga to Mulia, in Papua, Indonesia, would require either a deviation from a direct route or a circling climb to clear a 13,700-ft mountain, said the report by the Indonesian National Transportation Safety Committee.

The pilot likely had used a GPS receiver to fly a direct route.

Although the valleys were mostly clear, the mountains were shrouded by clouds when the single-engine airplane departed from Ilaga on a visual flight rules (VFR) flight the morning of April 17, 2009.

A search was launched when the Turbo Porter failed to arrive on time in Mulia. The next day, the wreckage was found on the mountain at about 12,000 ft. "The location was on the direct track between Ilaga and Mulia," the report said, noting that the pilot likely had used a global positioning system (GPS) receiver to fly a direct route.

The airplane had crashed in an inverted attitude. "The impact signature was consistent with uncontrolled flight at the time of impact," the report said. "This probably resulted from the pilot becoming spatially disoriented after entering cloud."

Autopilot Mode Mistake

Bombardier Q400. No damage. No injuries.

The Q400 was en route with 59 passengers and four crewmembers from Southampton, England, to Edinburgh, Scotland, on Dec. 23, 2008. Night VMC, with 10 km (6 mi) visibility, prevailed at the destination.

The Edinburgh approach controller issued a heading of 280 degrees to intercept the ILS localizer for Runway 24 and told the flight crew to descend from 3,000 ft to 2,100 ft and to maintain 160 kt until 4 nm (7 km) from touchdown.

"During the descent, the aircraft accelerated to approximately 200 kt with flap and landing gear up," said the AAIB report. "The aircraft did not level off as intended at 2,100 ft but continued to descend at a constant vertical speed such that it remained at all times below the ILS glideslope."

The approach controller apparently did not notice the deviation and told the crew to establish radio communication with the airport traffic controller. "At about this time, Flap 5 was selected and the aircraft decelerated to approximately 180 kt," the report said.

The airport controller noticed that the aircraft was substantially below the normal glide path and alerted the crew. "Is everything OK?" he asked.

The copilot replied, "We're going to level now. Actually, our glideslope capture obviously failed."

The commander saw that all four precision approach path indicator lights were red but did not recall any enhanced ground-proximity warning system (EGPWS) warnings. He disengaged the autopilot and stopped the descent about 700 ft above ground level. The crew then landed the Q400 without further incident.

Recorded flight data showed that the crew had selected the autopilot vertical speed mode to descend from 3,000 ft at a rate of 1,100 fpm. They had set 2,100 ft in the altitude selector but had not armed the autopilot altitude hold mode; thus, the autopilot remained in the vertical speed mode.

The crew had the runway in sight and therefore had not conducted a company ILS approach procedure that requires monitoring the vertical flight path by comparing indicated altitudes with altitudes shown on the approach chart.

Fog Imperils Night Visual Approach

Beech King Air B300. Destroyed. Two fatalities.

After completing a charter flight from Braunschweig, Germany, to Karlsruhe, the night of Jan. 12, 2006, the pilots decided to return to their home base in Freiburg under VFR.

Nearing the destination at 3,500 ft, the crew learned that weather conditions had deteriorated, said a report issued in late 2009 by the German Federal Bureau of Aircraft Accident Investigation.

An air inspection officer at Freiburg told the crew that ground visibility varied greatly, from about 1,500 m (4,921 ft) south of the airport to "much poorer" to the north. The estimates were based on visual observations.

Cockpit voice recorder (CVR) data indicated that the crew could not see the ground when they flew over the airport. "After a short discussion, the commander took a decision to fly an approach toward Runway 16," the report said.

The airport had no published approach procedure or navigation aids. CVR data indicated that the crew prepared for the approach by entering GPS waypoints in the flight management system and selecting a track of 163 degrees to follow the extended runway centerline.

The King Air was descending through a radio altitude of 1,000 ft when the copilot told the commander that he "could not yet see anything," the report said. "After passing through the 500-ft radio altimeter acoustic marker, the copilot had sideways visual contact with the ground but could see nothing in the direction of flight."

At 200 ft, the copilot told the commander that he saw a road. "It's probably the feeder road, but I can't be sure," he said.

Two seconds after an aural alert at 100 ft radio altitude was generated, the King Air struck trees on a hilltop about 700 m (2,297 ft) from the threshold of Runway 16. Fire fighters who arrived at the site soon after the accident estimated that visibility was 300 to 400 m (984 to 1,312 ft).

PISTON AIRPLANES

Worn Wires Ignite Ground Fire

Douglas DC-3. Substantial damage. No injuries.

The flight crew was taxiing the cargo airplane for departure from San Juan, Puerto Rico, the morning of April 26, 2009, when flames emerged from the cockpit floor and from the instrument panel.

"As the pilots were shutting down the engines, they became overwhelmed with fire and smoke, and quickly exited the airplane along with the two cargo handlers," the NTSB report said.

FAA inspectors who examined the airplane found signs of an intense fire. "Everything from the bulkhead behind the pilots' seats to the front of the airplane was melted," the report said.

The examination revealed that the insulation on two wires leading from the battery relay to the forward section of the cockpit had been abraded from contact between the wires.

The report indicated that the fire likely had been caused by contact between the exposed wires and worn aluminum fuel tubes leading to the fuel pressure gauges on the instrument panel. The report said that the fuel tubes had not been replaced since the DC-3 was built in 1942.

Oil Seals Omitted During Overhaul

De Havilland Beaver. Substantial damage. Five serious injuries, two minor injuries.

Day VMC prevailed when the float-equipped aircraft took off from Crossroads Lake, Newfoundland and Labrador, for a charter flight the morning of July 14, 2008. During the initial climb over land, the engine abruptly failed, said the report by the Transportation Safety Board of Canada (TSB).

The engine-failure procedure recommended by the DHC-2 flight manual is to "lower the nose to maintain the glide speed [and] land straight ahead or alter course slightly to avoid obstacles." However, the pilot initially banked right and then turned left toward a small pond.

The Beaver had turned about 130 degrees when it stalled and descended into a bog bordering the pond. "The cushioning effect of the bog prevented more serious damage [to the aircraft]," the report said. However, the pilot and four passengers were seriously injured, and two passengers sustained minor injuries. The report said that the pilot's head injuries might have been less severe if he had fastened his shoulder harness.

Investigators found that the pilot had reported oil pressure fluctuations between 50 psi, the lower limit, and 75 psi, the normal indication, during a local flight two days before the accident. "All other engine indications, including the oil quantity, were normal and the engine sounded normal," the report said.

Company maintenance personnel suspected that the oil pressure gauge was malfunctioning and determined that it would be safe to fly the aircraft until the gauge could be checked after the charter flight on July 14.

An examination of the nine-cylinder Pratt & Whitney R985 radial engine revealed that, during an overhaul two months before the accident, aluminum plugs had not been installed in the articulating rod link pins to seal the oil passage.

"Over the 90 [operating] hours since the engine was overhauled, the absence of the link pin plugs allowed a reduced oil pressure at the master rod bearing and crankpin interface," the report said. "This caused increased heat due to friction [and] accelerated wear and smearing of the bearing material, resulting in the lack of lubrication to critical engine components."

Goose Hits Truck

Grumman G21A. Substantial damage. One serious injury, eight minor injuries.

En route on a commuter flight from Akutan, Alaska, U.S., to Unalaska the afternoon of April 9, 2008, the pilot keyed his microphone seven times on the appropriate frequency to activate warning lights on a road that passes in front of the threshold of Runway 30 at the destination airport.

"Gates that were supposed to work in concert with the lights and block the runway from vehicle traffic were not operative," said the NTSB report. "On final approach, the pilot, who was aware that the gates were not working, noticed a large truck and trailer stopped adjacent to the landing threshold. As he neared the runway, he realized that the truck was moving in front of the threshold area."

The pilot attempted to go around, but the belly of the Goose struck the top of the trailer. One passenger was seriously injured when the airplane descended out of control onto the 3,900-ft (1,189-m) runway.

The truck driver, who was not hurt, told investigators that he had seen the road warning lights and waited for about 45 seconds. He said that he then looked for but did not see any landing aircraft and continued driving.

"According to the Unalaska police officer assigned to the accident case, the truck driver did not have a valid driver's license," the report said. "Also, his commercial driver's license was suspended."

HELICOPTERS

Disorientation Cited in EMS Crash

Sikorsky S-76A. Substantial damage. Three serious injuries.

The emergency medical services (EMS) helicopter departed from Sudbury, Ontario, Canada, the night of Feb. 8, 2008, to rendezvous with an ambulance at Snake Lake Helipad in Temagami.

"The entire region was experiencing localized light to moderate snowfall, and it was uncertain as to whether the flight would be able to land in Temagami," the TSB report said.

However, the flight crew found that visibility was no less than 4 mi (6 km) during the flight and improved as they neared the destination. They did not request activation of the helipad perimeter lights.

"During the last 1.5 minutes of the approach, the pilot flying [the captain] was explaining to the [first officer] what he was doing, step by step, and what to watch out for during night approaches, including black hole illusions," the report said. "This likely distracted the pilots [from] the task at hand."

The "task" was a night visual approach in black hole conditions. The approach path selected by the captain passed over the town and a small hill on the southwest shore, and then crossed a narrow section of the lake to the helipad on the northeast shore.

The report said that the captain likely became spatially disoriented after crossing the hill. He perceived that the helicopter was too high and increased the rate of descent to more than 1,400 fpm, "well in excess of the recommended maximum descent rate of 750 fpm," the report said.

The helicopter descended nearly vertically into trees near the southwest shore of the lake and about 814 ft (248 m) from the helipad. The two paramedics and one of the pilots — the report did not say which pilot — were seriously injured. The extent of injury to the other pilot also was not specified.

Preliminary Reports, February 2010

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Feb. 1	Watertown, New York, U.S.	Cessna 402C	substantial	7 none
The landing gear collapsed when the 402 landed long with a tail wind and overran the snow-covered runway.				
Feb. 2	Munich, Germany	Cessna 425 Conquest 1	substantial	2 none
The emergency medical services (EMS) airplane struck terrain short of the runway after both engines lost power on approach.				
Feb. 4	Restauración, Dominican Republic	Robinson R44	destroyed	2 fatal
The helicopter struck a mountain during a night flight from Port-au-Prince, Haiti, to Santiago, Dominican Republic.				
Feb. 4	Yakutsk, Russia	Antonov 24RV	substantial	42 none
The nosegear collapsed during a rejected takeoff following an engine failure.				
Feb. 4	Amarillo, Texas, U.S.	Mitsubishi MU-2B-60	substantial	4 none
The MU-2 veered off the snow- and ice-covered runway during a night landing.				
Feb. 5	Horni Olesna, Czech Republic	Bell 427	destroyed	3 none
The pilot was attempting to maneuver out of an area of thick fog when the EMS helicopter struck terrain.				
Feb. 5	El Paso, Texas, U.S.	Aerospatiale AS 350-B2	destroyed	3 fatal
The pilot was using night vision goggles when the helicopter crashed on landing during a night EMS training flight.				
Feb. 8	Lawrenceville, Georgia, U.S.	Beech Queen Air	destroyed	1 fatal, 3 minor
The pilot was killed when the Queen Air struck terrain after both engines failed during a night takeoff.				
Feb. 10	Amsterdam, Netherlands	Boeing 737-300	none	100 none
The flight crew was cleared to take off from Runway 36C at Schiphol Airport but departed instead from a parallel taxiway.				
Feb. 11	Kutai Kartanegara, Indonesia	ATR 42-300	substantial	2 serious, 54 none
An engine failed en route to Samarinda, and the crew diverted to Balikpapan, which has better facilities. The other engine failed shortly thereafter, and the aircraft was landed in a rice field.				
Feb. 11	Monterrey, Mexico	Fokker 100	substantial	96 none
Unable to extend the left main landing gear on approach to Nuevo Laredo, the crew diverted to Monterrey, where the Fokker veered off the runway on landing.				
Feb. 12	Forest City, Iowa, U.S.	Piper Cheyenne II	destroyed	1 fatal
A witness said that the Cheyenne veered sharply left on final approach and descended rapidly to the ground.				
Feb. 13	Santa Clarita, California, U.S.	Boeing 737-700	none	1 serious, 1 minor, 83 none
Two flight attendants were injured when the captain initiated a 1,500- to 2,000-fpm descent in response to a traffic-alert and collision avoidance system resolution advisory.				
Feb. 14	Schöna, Germany	Cessna Citation Bravo	destroyed	2 fatal
En route from Prague, Czech Republic, to Kalstad, Sweden, the Citation crashed shortly after being cleared to climb from FL 260 to FL 330.				
Feb. 14	Cave Creek, Arizona, U.S.	Eurocopter EC 135-T1	destroyed	5 fatal
Witnesses heard "popping sounds" and saw the helicopter rotate several times, pitch nose-down and descend to the ground.				
Feb. 16	Teterboro, New Jersey, U.S.	Bombardier CRJ200	minor	14 none
The CRJ overran the runway during a night landing.				
Feb. 17	Palo Alto, California, U.S.	Cessna 310R	destroyed	3 fatal
Night instrument meteorological conditions prevailed when the 310 struck power lines on takeoff and crashed into several residential structures. No one on the ground was hurt.				
Feb. 19	Carayaca, Venezuela	Bell 206B JetRanger	destroyed	4 fatal
The helicopter crashed in mountainous terrain during an EMS flight from Caracas to Yaracal.				
Feb. 21	Turin, Italy	Boeing 757-200	none	239 none
An uncommanded fuel jettisoning occurred during initial climb.				
Feb. 25	Nazca, Peru	Cessna U206F	destroyed	7 fatal
The single-engine airplane crashed during a commercial sightseeing flight.				
Feb. 26	Ambergris Caye, Belize	Cessna U206G	destroyed	5 fatal
The airplane, a Soloy turboprop conversion, had a technical problem on final approach and crashed short of the runway.				
Feb. 26	Nova Lima, Brazil	Cessna 310R	destroyed	2 fatal
Visibility was limited by fog when the 310 crashed close to the top of a ridge during takeoff.				

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

Selected Smoke, Fire and Fumes Events in the United States, November 2009–January 2010

Date	Flight Phase	Airport	Classification	Sub-classification	Aircraft Model	Operator
Nov. 10	Climb	San Jose, California (SJC)	Diversion, emergency landing	Fumes in cockpit	Embraer EMB-190	JetBlue Airways
On climbout through Flight Level 290, the crew received a "TAT 1 FAIL" EICAS (engine indicating and crew alerting system) message, followed by autothrottle disconnect and a strong odor of electrical fumes. The autothrottle and autopilot would not re-engage. An emergency was declared with a diversion to SJC. The odor continued through the descent and landing.						
Nov. 13	Climb	Los Angeles (LAX)	Return to airport, unscheduled landing	Fumes in cabin	McDonnell Douglas DC-9	American Airlines
After takeoff, flight attendants reported fumes in the cabin. The airplane was returned to LAX and landed without incident. Maintenance technicians replaced the pressure regulator valve in the tail section.						
Nov. 18	Cruise	Chicago (ORD)	Diversion, emergency landing	Smoke in cockpit	Airbus A319	Allegheny Airlines
While en route from Los Angeles to Boston at Flight Level 370, the right cockpit window exhibited arcing and smoke. Five minutes later, the window shattered. The flight crew declared an emergency, diverted and made an emergency descent to ORD.						
Nov. 18	Cruise	Miami (MIA)	Unscheduled landing	Smoke in cockpit	Boeing 767	American Airlines
The crew reported an EICAS alert for the forward equipment exhaust fan, followed by an electric odor and smoke in the cockpit. The airplane was given priority for landing. Maintenance technicians replaced the forward equipment exhaust fan.						
Nov. 20	Climb	—	Emergency landing	Fumes in cabin	Boeing 757	American Airlines
Electrical fumes were reported in the cabin. An emergency was declared. Maintenance technicians found that the right recirculation fan had failed.						
Nov. 23	Cruise	Albany, New York (ALB)	Diversion, unscheduled landing	Smoke in cockpit	Embraer EMB-145LR	Continental Express Airlines
The flight crew reported smoke in the cockpit and the no. 2 multi-function display circuit breaker "popped." The flight was diverted and the aircraft landed uneventfully.						
Nov. 26	Cruise	—	Diversion, unscheduled landing	Smoke in cockpit	Boeing 767	North American Airlines
During the last hour of flight, a strong electrical burning smell emanated from the cockpit. The pilots consulted the quick reference handbook, and a landing was made at the nearest airport. Maintenance technicians found that a forward exit equipment cooling fan circuit breaker was defective and replaced it.						
Dec. 14	Cruise	Atlanta (ATL)	Diversion, unscheduled landing	Smoke in cockpit	Embraer EMB-145XR	Continental Express Airlines
The crew reported smoke in the cockpit during the flight. The aircraft was diverted to ATL, where it was landed without incident.						
Dec. 15	Descent	—	Emergency landing	Smoke in cockpit	Airbus A320	Northwest Airlines
Nearing the descent, the crew smelled a burning odor. An emergency was declared, followed by an uneventful landing. Maintenance technicians found left cabin recirculating fan damage.						
Dec. 18	Descent	Houston (IAH)	Emergency descent	Smoke alert	Embraer EMB-145LR	Continental Express Airlines
During the descent, the crew reported a baggage compartment fire indication without an alarm or EICAS message. The aircraft was landed without incident. Maintenance technicians replaced the baggage compartment recirculation fan.						
Dec. 28	Approach	Charlotte, North Carolina (CLT)		Smoke in cockpit	Airbus A321	Allegheny Airlines
On short final, a blower/extract fan started, and a loud noise was heard, followed by electrical smoke. Maintenance technicians later replaced the avionics extract fan.						
Dec. 29	Climb	Dallas (DFW)	Return to airport, unscheduled landing	Smoke in cockpit	Embraer EMB-145LR	American Eagle Airlines
During climb, the crew reported an odor of ash and smoke in the cockpit. The crew elected to return to DFW.						
Jan. 25	Climb	—	Diversion, unscheduled landing	Smoke in cockpit	Airbus A319	Delta Air Lines
During the climb, a rumbling noise was heard for several minutes followed by acrid smoke on the flight deck. The aircraft was diverted. While the descent was in progress, an extract fan fault was annunciated. The landing was uneventful. Maintenance technicians replaced the avionics extract fan.						
Jan. 25	Descent	New York (JFK)	—	Smoke in cockpit	Embraer EMB-190	JetBlue Airways
During descent, the crew reported a grinding noise, and a light vibration was noticed on the flight deck. This was followed by a strong burning odor on final approach with the grinding noise becoming louder.						
Jan. 29	Cruise	Philadelphia (PHL)	Diversion, unscheduled landing	Smoke in cockpit, smoke in cabin	Embraer EMB-145XR	Continental Express Airlines
The crew reported a smoke smell in the cockpit and cabin. The aircraft was diverted to PHL and landed without incident.						

Source: Safety Operating Systems and Inflight Warning Systems

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