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THE JOURNAL OF FLIGHT SAFETY FOUNDATION

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EMBRACING Challenges

On March 8, the Royal Aeronautical Society, Washington Branch, presented its Trans-Atlantic Leading Edge Award to Flight Safety Foundation President and Chief Executive Officer William R. Voss for his work coordinating safety efforts in North America and Europe. Here are the remarks he made in accepting the award:

In accepting this first Trans-Atlantic Leading Edge Award, I feel the need to reflect on the role of the traditional transoceanic relationship in the context of the new global aviation market that is beginning to emerge. Ten years ago, the dynamics were pretty simple — 40 percent of the world's traffic was in the United States, 40 percent originated in Europe, and the remaining 20 percent was scattered rather thinly across the world. Regulators outside the United States and Europe adopted a wise and pragmatic strategy. They waited until the United States and the Europeans dealt with things, and then adopted those rules and strategies.

Things are looking different today, and they will be radically different tomorrow. Based on both the Airbus and Boeing market forecasts, the common assumption is that air traffic growth will be linked inextricably to the distribution of middle-class consumers. In 2010, there were about 1.8 billion people in the middle class around the world, and about 1 billion of them were in the United States and Europe. In 2030, there will be nearly 4.9 billion people in the middle class. The same billion or so are expected to reside in the United States and Europe, where middle-class growth is expected to be nil. The 3 billion new members of the middle class will show up in places like Asia and Latin America. That will certainly upset the balance of power that has driven aviation. Clearly, it is time to think about how the United States and Europe can fulfill the role of aviation leader in a very different world in the near future.

As members of the old ruling alliance, we can no longer assume that the future challenges of aviation will be faced in our own backyard. The future problems of training, growth and congestion will be fought on far-off battlefields. We will not even be aware of them unless we choose to make it our business. We will be dealing with parochial problems, like considering what to do when the Federal Aviation Administration runs out of regulatory authority and Europe runs out of inspectors.

So I have a simple message to my colleagues who have served this proud Trans-Atlantic Alliance. Do not assume that our past achievements guarantee future relevance. Destiny placed us at center stage for 50 years. Our significance over the next 20 years will be defined by our willingness to embrace other regional challenges, and our commitment to solve them. Doing anything less will guarantee a rapid retreat from the spotlight.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWorld

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An overrun damaged a Falcon 900 like this one.
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications J.A. Donoghue, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA or donoghue@flightsafety.org.

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Short Final

The aviation industry is, to me, a magical place, where very smart people cooperate with near perfection to move massive numbers of people and tons of cargo through air too thin to breathe, a miracle that happens every hour of every day, give or take a volcanic eruption. Absent natural catastrophes and man-made disasters like wars and terrorism, the flow continues, moving people and stuff around the globe, creating a system of travel and commerce that breaks down international barriers that have stood for millennia.

Watching a documentary about The Beatles' early days, I saw an interview with the band after their first visit to France, a country you can see from England on a clear day. The lads were asked how they found France, and what was the electricity like there? Today, this question seems silly beyond belief, but in 1964, on the brink of the transportation revolution, even close neighbors were not much informed about each other, and distant countries and cultures might as well have been on the far side of the moon, remote and unknowable.

Now, of course, international travel is available to any member of the global middle class, which is growing by 10 million every month, in part due to the energetic international trade invigorated by tourism and air cargo. As Flight Safety Foundation has discussed, this rapid expansion of the prospective passenger pool creates a new catalog of threats and risks, chief among them the difficulty of maintaining quality oversight of system growth and finding personnel properly trained to run the system. India and Indonesia are good examples of what can happen when very strong economic expansion butts up against an overwhelmed political structure, but these are only the most obvious examples; as Flight Safety Foundation Chairman and CEO Bill Voss points out, risks lurk even in the most mature aviation markets as budget pullbacks threaten oversight.

Today's safety challenge is not the same as in past decades, when the search focused on how to fly safely. FSF Director of Technical Programs Jim Burin constantly reminds us that while our current system is very safe, there will never be a flight with zero risk, wisdom traceable to Orville Wright. However, we now know how to reduce that risk to levels we can call safe. Today's challenge is to disseminate that information around the world, and this is a major component of what drives Flight Safety Foundation's activities.

I'm trying to say that I consider aviation not only magical but also essential to the world's continued development, and that the Foundation — and the rest of the aviation safety community — play critical roles in keeping it the dependable transportation mode it has become, with improvements continually in process.

Now, as I retire, I know I am very fortunate to have been part of this magical community. Starting as a military pilot at age 18, I have somehow been able to either fly or write about flying — mostly write — for my entire professional career. Amazing.

This is my last issue of *AeroSafety World*, but the magazine and the Foundation will continue without pause, bringing you the most up-to-date safety information available. I hope to maintain some connection with the Foundation, but it is time to transfer control of the process. So to Frank Jackman, *ASW*'s new editor-in-chief, I say, "You've got it."

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

Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,075 individuals and member organizations in 130 countries.

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STUDENT Membership

I am composing this article at Purdue University in West Lafayette, Indiana, located in the Midwestern United States. Flight Safety Foundation has formed its first university student membership chapter there. This is part of the value proposition that I wrote about in last month's column. Students, whether they are in college or high school, are now eligible to be a member of the Foundation for a very nominal fee, US$30.

For many years we have all attended meetings, seminars and conferences, seeing familiar faces of colleagues. However, I noticed that we were not seeing many new and younger faces. To accommodate the additional human resources we will need for the future of aviation safety, we must cultivate interest at an earlier stage in a person's aviation career. What better place to start than at the university level, in schools that have aviation programs?

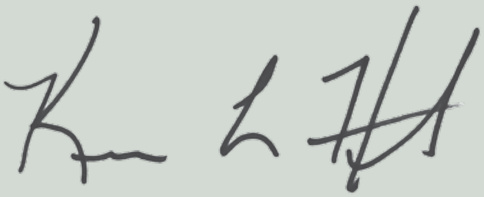
Purdue University, as the takeoff site for our first student chapter, has many firsts in academic aviation: the first to have its own airport; to have many famous aviators, such as Amelia Earhart, lecture there; and to have full motion airliner simulators as part of the educational curriculum. So it naturally made sense for Purdue to be the first of what we hope will be many universities worldwide to have student chapters.

The chapters have a full set of protocols that outline the relationship among the Foundation, the university and students. There are provisions for chapter presidents, vice presidents and secretary-treasurers. Those officers will coordinate projects between their chapter and the Foundation. The projects will include work in technical research areas such as safety management systems, go-around guidelines and data analysis. That will be accomplished by visits to the Foundation offices in Alexandria, email and video conferencing. The projects will also allow the students to get involved with some of our members that have great technical and analytical departments.

For those of you who attend our conferences, we are contemplating giving the students a small portion of our agenda schedule to actually make a presentation on various items they have worked, or are currently working, on. That will provide the attendees a perspective from perhaps a different angle-of-attack and let the students experience what it is like to give a presentation in a professional setting, which many don't get the chance to do.

Our dream is that this membership category will grow very quickly to include many other universities worldwide, and also independent students who may not have access to a chapter. The value proposition is great. The student receives the *AeroSafety World* magazine, access to our website's new section for members only, and the hundreds of archived articles from the Foundation for their research papers, plus reduced admission to any of the Foundation seminars.

Student members and university Flight Safety Foundation chapters — what better way to cultivate the next generation aviation and safety professional!



Capt. Kevin L. Hiatt
Chief Operating Officer
Flight Safety Foundation

Know Your Systems

I read with great interest the *ASW* cover story for December 2011–January 2012 when I saw the photograph caption, "This aircraft struck terrain while departing with the flaps and slats retracted." I thought to myself in disbelief, "What? No takeoff warning? Again?"

Dishearteningly, I believe that from a maintenance perspective at least, this was a preventable accident. Had the technicians and the flight crew better analyzed and understood the problem of the ram air temperature (RAT) probe overheating and realized the implications of the probe being heated on the ground in the first place, this tragedy might not have happened. I also read the report by Spain's Civil Aviation Accident and Incident Investigation Commission (CIAIAC) and was very surprised to see that, in spite of the attention given to the R2-5 relay as a possible cause of the takeoff warning system (TOWS) not operating properly and how it controls the RAT probe heat, the relay, or at least its functionality, was not declared the "smoking gun" in the accident.

On the MD-82 aircraft the RAT probe heater is electrically powered "ON" when the aircraft is in the air and it is "OFF" (not powered) when the aircraft is on the ground. This on/off circuit is controlled by the R2-5 relay air/ground logic through an electrical ground input via a "nose landing gear down" and a "nose landing gear oleo" switch. The R2-5 relay is energized when the aircraft is on the ground and de-energized in flight. Thus, the R2-5 relay "fail mode" is to the flight mode. In other words, if the controlling circuit to the R2-5 relay from the aircraft's electrical systems should fail, the relay would de-energize and the systems controlled by the R2-5 relay would operate "normally" as if the aircraft were in flight.

In addition to controlling the RAT probe heat, the R2-5 relay provides control inputs to three other systems, none of which would have a flight deck effect if the R2-5 relay was in the "flight" mode while the aircraft was on the ground. The R2-5 relay controls an "inhibit" signal to the aircraft's electrical system AC [alternating current] bus control unit "AC CROSS-TIE" circuit when the aircraft is on the ground. This inhibit signal prevents the aircraft's left and right buses from being connected to each other when the APU [auxiliary power unit] or an external power source is powering the buses.

The R2-5 relay controls the standby radio rack fan from being powered "ON" in flight by removing an electrical ground from the fan control circuit when the radio rack fan switch is placed in the "Venturi" position. And the R2-5 prevents TOWS warnings in flight by supplying an electrical ground input to the central aural warning unit.

On the ground, a malfunction of the R2-5 relay or its controlling circuit would not provide any indication of a faulty TOWS unless a check of the TOWS was performed by the flight crew (one of the CIAIAC's recommendations) prior to takeoff. Under normal conditions, the only indication the flight crew would have of the R2-5 relay air/ground circuits being in the "flight" mode when the aircraft is on the ground would be exactly what was noticed: the RAT probe overheating.

Although the CIAIAC report discussed the possibility of faulty contacts in the R2-5 relay as possibly affecting the TOWS and RAT probe heat, and in spite of the inconclusive findings by the CIAIAC of the R2-5 relay being the cause of the faulty TOWS, the fact is that the RAT probe could not have been "ON" and overheated on the ground unless the R2-5 relay contacts powering the RAT probe heat were in the "flight" mode. And if the R2-5 relay was in the "flight" mode while the aircraft was on the ground, then the TOWS would be inhibited.

I was pleased to see that one of the recommendations made by the CIAIAC was the "requirement that the source of the malfunction be identified before using an MEL [minimum equipment list]." However, I was disappointed that this recommendation was made only applicable to the RAT probe heat system. I believe identifying the source of a malfunction prior to applying the MEL is crucial, particularly when something is operating when it should not be. Not doing so has the potential for improperly applying the MEL to render what appears to be a malfunctioning system "inoperative" when that system is operating when it should *not* be.

This is not to say that the MEL cannot or should not be applied in some of these cases. But often, if something is operating when it should not be, the fault is in another system. In this case, I believe the RAT probe overheating was an indication of a bigger problem that deserved closer scrutiny. I cannot stress enough the importance of understanding how the applicable aircraft systems that we apply the MEL to are *supposed* to work before we point to them as being the faulty systems.

Regardless of the CIAIAC's findings as to the cause of this accident, I will use this accident as a teaching tool for the importance of understanding how a system is supposed to work, identifying the source of an apparent malfunction before using the MEL, and the potential life-threatening consequences of not doing so.

Jeffrey Gibler
Shift Manager, Aircraft Maintenance
George Bush Intercontinental Airport, Houston
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Wind Farm Turbulence

I am writing in the hope that readers of *ASW* may be aware of research or data pertaining to the generation of wake turbulence by a wind turbine and the threat this turbulence may pose to aircraft flying at a low level.

There is little doubt that wind turbines generate unstable air on their lee side, as this is the very reason turbines are spaced apart in wind farms. My question is, "Could the severity of the turbulence generated by one or more turbines be sufficient to cause a flight risk to small or medium-sized aircraft entering the wake turbulence area?"

Wind farms are relatively new to Australia, and aerial firefighting agencies are looking to develop policies which will guide aerial firebombing pilots on how to fly safely in the vicinity of these structures. Any data that readers have on this topic would be greatly appreciated. Material can be emailed to <inman.janet@cfs.sa.gov.au>.

Janet Inman
Aviation Standards Officer
South Australian Country Fire Service

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.

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APRIL 17 ➤ Air Cargo Safety and Security Conference. Air Line Pilots Association, International. Washington. <eas@alpa.org>, <cargoconference.alpa.org>, 800.424.2470; +1 703.689.2270.

APRIL 17–18 ➤ Evaluation of Safety Management Systems Course. CAA International. London Gatwick Airport area. <Training@caainternational.com>, <www.caainternational.com>, +44 (0)1293 768821.

APRIL 17–26 ➤ Aviation System Safety Management Course. (L/D)max Aviation Safety Group. Albuquerque, New Mexico, U.S. <info@ldmaxaviation.com>, <bit.ly/fqQpPf>, 877.455.3629, +1 805.285.3629.

APRIL 18–19 ➤ Corporate Aviation Safety Seminar. Flight Safety Foundation and the U.S. National Business Aviation Association. San Antonio, Texas, U.S. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/cass>, +1 703.739.6700, ext. 101.

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APRIL 25 ➤ AViCON: Aviation Disaster Conference. RTI Forensics. New York. <www.rtiforensics.com/news-events/avicon>, +1 410.571.0712; +44 207 481 2150.

MAY 3–7 ➤ IFALPA Annual Conference. International Federation of Air Line Pilots' Associations. Paris. <www.ifalpa.org/store/2012Ann1.pdf>.

MAY 7–8 ➤ Safety in Aviation Asia. Flightglobal. Singapore. Hannah Bonnett, <Hannah.bonnett@rbi.co.uk>, <www.flightglobalevents.com/safety2012>, +44 (0)20 8652 4755.

MAY 7–11 ➤ Advanced Aircraft Accident Investigation Training. Embry-Riddle Aeronautical University. Prescott, Arizona, U.S. Sarah Ochs, <case@erau.edu>, <www.erau.edu/case>.

MAY 8–9 ➤ Human Factors for Aviation Managers and Technicians Workshop (Initial). Grey Owl Aviation Consultants. Buffalo, New York, U.S. Richard Komarniski, <Richard@greyowl.com>, <www.greyowl.com/courses/desc_hf-phase1.html>, +1 204.848.7353.

MAY 14–15 ➤ HFACS/HFIX Workshop. HFACS Inc. Amsterdam. <dnlmccn@yahoo.com>, <bit.ly/AhJeXU >, 800.320.0833.

MAY 14–16 ➤ Middle East Regional Safety Seminar. International Civil Aviation Organization and International Air Transport Association. Amman, Jordan. <www.icao.int/Meetings/AmmanRRSS/Pages/default.aspx>.

MAY 14–16 ➤ SMS Audit Procedures Course. Aerosolutions. Ottawa. <aerosolutions@rogers.com>, <bit.ly/wdrCOC>, +1 613.821.4454.

MAY 14–16 ➤ European Business Aviation Convention and Exhibition (EBACE). European Business Aviation Association and U.S. National Business Aviation Association. Geneva. Gabriel Destremaut, <gdestremaut@ebaa.org>, +32 2-766-0073; Donna Raphael, <draphael@nbaa.org>, +1 202.478.7760; <www.ebace.aero/2012>.

MAY 15–16 ➤ International Safety Workshop: Machine–Human–Environment. Flight Safety Foundation International. Moscow. Dmitry Tarasevich, <fsfi@fsfi.civilavia.ru>, <www.flightsafety.ru>, fax +7 499.151.7841

MAY 15–16 ➤ Third European Safety Management Symposium. Baines Simmons. London. <info@bainessimmons.com>, <bit.ly/ttot0B>, +44 (0)1276 855412.

MAY 16–17 ➤ Regulatory Affairs Training Course. JDA Aviation Technology Solutions. Fort Worth, Texas, U.S. Roxana Hinostroza, <rhinostroza@dasolutions.aero>, <jdasolutions.aero/services/regulatory-affairs.php>, 877.532.2376, +1 301.941.1460, ext. 110.

MAY 20–22 ➤ FAA/AAAE Airfield Safety, Sign Systems and Maintenance Management Workshop. American Association of Airport Executives and U.S. Federal Aviation Administration. Houston. <AAAEMeetings@aaae.org>, <bit.ly/u5aSjh>.

MAY 21–24 ➤ Asia-Pacific Regional Runway Safety Seminar. International Civil Aviation Organization, Flight Safety Foundation, and Association of Asia Pacific Airlines. Bali, Indonesia. <www.icao.int/Meetings/BaliRRSS/Pages/default.aspx>.

MAY 21–25 ➤ Maintenance Accident Investigation Course. (L/D)max Aviation Safety Group. Portland, Oregon, U.S. <info@ldmaxaviation.com>, <bit.ly/iYEGyl>, 877.455.3629, +1 805.285.3629.

MAY 22–24 ➤ ATCA Technical Symposium. Air Traffic Control Association, U.S. Federal Aviation Administration and U.S. National Aeronautics and Space Administration. Atlantic City, New Jersey. Kenneth Carlisle, <ken.carlisle@atca.org>, <www.atca.org/techsymposium>, +1 703.299.2430, ext. 310.

JUNE 11–12 ➤ Flight Operations Manual Workshop: Employing IS-BAO. National Business Aviation Association. Chicago. Sarah Wolf, <swolf@nbaa.org>, <bit.ly/ye4ei9>, +1 202.783.9251.

JUNE 12–13 ➤ Evaluation of Safety Management Systems Course. CAA International. Manchester Airport area. <Training@caainternational.com>, <www.caainternational.com>, +44 (0)1293 768821.

JUNE 14–15 ➤ Overview of Aviation Safety Management Systems Training. ATC Vantage. Tampa, Florida, U.S. Theresa McCormick, <tmccormick@atcvantage.com>, <atcvantage.com/sms-workshop.html>, +1 727.410.4759.

JUNE 18 ➤ EASA Part M — Continuing Airworthiness Training. Avisa Safety System. Manchester, England. <bit.ly/yagAio>.

JUNE 18 ➤ Implementing a Just Culture. Baines Simmons. Surrey, England. <info@bainessimmons.com>, <bit.ly/whV9l4>, +44 (0)1276 855412.

JUNE 19–21 ➤ Airport Wildlife Mitigation Seminar. Embry-Riddle Aeronautical University. Dallas. <bit.ly/8XJejE>.

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

Safety News

A380 Oil Leaks

An investigation has identified high oil-feed pipe deflection loads as a significant factor in in-flight engine oil leaks on two Qantas Airways Airbus A380s, the Australian Transport Safety Bureau (ATSB) says.

The ATSB said in its final report on the two 2011 incidents that examination and testing by Rolls-Royce, the manufacturer of the Trent 900 engines, determined that the oil leaks "were the result of a loss of clamping force on the oil-feed pipe connection at the engine casing."

Both incidents occurred during scheduled passenger flights from Singapore to London.

In the first incident discussed in the report, on Feb. 24, 2011, about eight hours after departure, the flight crew observed a reduction in the no. 3 engine's indicated oil tank quantity. They reduced engine thrust to idle and continued to London. Maintenance personnel subsequently found a leak from an external oil-feed pipe, which was finger tight.

There had been three similar oil leaks on other Qantas A380s, the report said.

By Nov. 3, the date of the second incident discussed in the report, 15 such engine oil leaks had been reported worldwide.

In the Nov. 3 incident, about three hours after departure, the crew observed a low oil quantity advisory for the no. 4 engine. That was followed 40 minutes later by a low oil pressure warning for the same engine. The crew shut down the engine and diverted to Dubai, United Arab Emirates.

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Maintenance personnel found a leak in an engine oil-feed pipe "in the same location as the earlier A380 engine oil loss events," the report said.

As a result of its investigations, the manufacturer modified the "oil pipe clipping arrangement and revised securing methods for the pipe connection and deflector assembly," the report said. "In addition, trend monitoring of engine oil consumption was enhanced and work continued to develop a new oil pipe design."

Volcanic Ash Guidance

The International Civil Aviation Organization (ICAO) has published a manual providing guidance for air transport operators in case of a volcanic eruption.

ICAO Doc 9974, *Flight Safety and Volcanic Ash*, is based on work done by the ICAO International Volcanic Ash Task Force, which was established after the eruptions in 2010 of Iceland's Eyjafjallajökul Volcano, which disrupted air traffic in much of Europe.

"The impact on air travel of the Eyjafjallajökul eruption was unprecedented," said ICAO Secretary General Raymond Benjamin. "It forced us to align our guidance material with the latest technological and scientific developments. The new approach, while ensuring the safety of flight operations, provides more flexibility and recommends that the decision to operate a flight in airspace containing volcanic ash rest with airlines, under the supervision of state regulatory authorities."

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New Standards

The European Business Aviation Association (EBAA) says it is developing a set of safety standards for the handling of aircraft in Europe's smaller airports.

The International Standard for Business Aircraft Handling (IS-BAH) will be modeled on the International Business Aviation Council's International Standard for Business Aircraft Operations (IS-BAO), EBAA President Brian Humphries said.

IS-BAH will apply to airports with fewer than 2 million passengers a year that are not subject to the European Union ground handling regulations that apply to larger airports, Humphries said.

"We will conduct our own quality and safety assessments of fixed base operators and ground handling against this standard, enhancing both safety and the customer experience to the benefit of all," he said.


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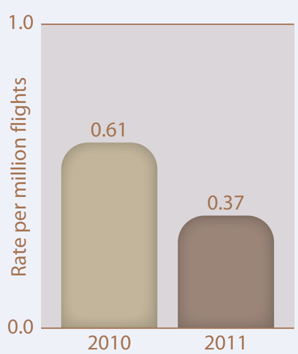
Data Show Accident Rate at New Low

The 2011 accident rate for Western-built jets was the lowest ever recorded, according to data compiled by the International Air Transport Association (IATA).

The data, based on hull losses of Western-built jets, showed a 2011 global accident rate of 0.37 per million flights — the equivalent of one accident every 2.7 million flights, compared with the 2010 rate of 0.61 per million flights — or one accident every 1.6 million flights.

IATA defines a hull loss as an accident in which an aircraft is either destroyed or substantially damaged and not repaired.



"Flying is one of the safest things that a person could do," said IATA Director General and CEO Tony Tyler. "But every accident is one too many, and each fatality is a human tragedy. The ultimate goal of zero accidents keeps everyone involved in aviation focused on building an ever safer industry."

Regionally, accident rates ranged from 0.0 per million flights in Europe and North Asia to 3.27 per million flights in Africa, IATA said.

Missed Deadlines

The U.S. Federal Aviation Administration (FAA) has not met the "timelines" established in a 2010 law calling for the implementation of stricter pilot training standards and higher minimum pilot qualifications, the Department of Transportation's inspector general says.

Testifying before Congress in late March, Inspector General Calvin L. Scovel III said that the FAA also is behind schedule in implementing mentoring programs and "providing enhanced leadership skills to captains." The agency also "faces challenges in establishing a pilot records database," he said.

He noted that the FAA either has complied with or is headed toward compliance with other provisions of the law, including upgrading pilot rest requirements. The FAA announced changes in flight and duty time regulations in January.

Airline Accused of Rest Rule Violations

The U.S. Federal Aviation Administration (FAA) is proposing a $153,000 civil penalty against Colgan Air because of allegations that the airline conducted 17 flights in 2008 and 2009 without scheduling the required minimum rest periods for pilots and flight attendants.

According to the FAA's allegations, "between June 14, 2008, and Feb. 23, 2009, Colgan scheduled flight duty time for two captains, two first officers and six flight attendants on a seventh day, after they had been on duty for the previous six consecutive days."

Under FAA regulations, the airline was required to provide each crewmember with at least 24 consecutive hours of rest during each seven-day period. Of the 10 flight crewmembers, one captain operated four flights without an adequate rest period; the other nine crewmembers worked on one flight each without adequate rest, the FAA said.

Other allegations are that Colgan failed, three times in 2008, to give three flight attendants "a required scheduled rest period of at least eight consecutive hours after scheduling them on flights after their previous duty period" and that a first officer was scheduled for flight time, also in 2008, when his commercial flight time "exceeded eight hours between required rest periods."

Colgan had 30 days to respond to the allegations.

The alleged violations involved FAA flight, duty and rest rules that have been designated to be replaced in December 2013 with new rules intended to fight fatigue by requiring longer rest periods.

Fatigue was considered a likely factor in the fatal Feb. 12, 2009, crash of a Colgan Bombardier Q400 during approach to Buffalo Niagara (New York, U.S.) International Airport, the U.S. National Transportation Safety Board (NTSB) said, although its final report on the accident also said that investigators could not determine precisely how fatigue might have contributed to the crew's "performance deficiencies."

All 49 people in the airplane and one person on the ground were killed when the airplane struck a house near the airport. The NTSB cited the captain's inappropriate response to a stick-shaker activation as the probable cause.

Helmets for Helicopter Pilots

The Transportation Safety Board of Canada (TSB), citing the May 20, 2011, crash of a Bell 212 on a firefighting mission, has reiterated its call for helicopter pilots to wear safety helmets.

The Campbell Helicopters 212 crashed in Slave Lake in Alberta during an approach to the lake to pick up water to be used in fighting a nearby forest fire. The pilot — the only person in the helicopter — was killed in the crash, and the helicopter, which sank in the lake, sustained major damage, the TSB said.

The pilot's death was a result of head injuries that he received in the impact, the TSB said in its final report on the crash. Accident investigators found the pilot's helmet inside its bag in the helicopter cabin, the report said, noting that the operator did not require its pilots to wear helmets and that no regulations require protective headgear.

The report cited research that has found that the risk of fatal head injuries in a crash is as much as six times greater for helicopter pilots and other helicopter occupants who do not wear helmets.

"The lack of regulations or policies requiring helicopter pilots to wear helmets places them at greater risk of incapacitation due to head injuries following a ditching or a crash," the report said.

The TSB noted that Transport Canada also has recommended helmet use by commercial helicopter pilots, as well as student helicopter pilots, and has recommended that helicopter operators encourage their pilots to wear helmets.

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Underutilized Technologies

The technological equipment in today's advanced aircraft is not being fully utilized because air traffic management (ATM) systems have not developed at the same pace, officials from Boeing and the Civil Air Navigation Services Organisation (CANSO) say.

Although today's ATM systems are "highly optimized," the aviation industry must attempt to use existing aircraft capabilities to better manage traffic in congested environments, Neil Planzer, vice president of air traffic management for Boeing Flight Services, and CANSO Chairman Paul Riemens said in a paper presented to the sixth Aviation and Environment Summit in Geneva.

"The capabilities of today's high-technology airplanes are underutilized in the current constrained and outdated ATM system, undermining the profitability of the aviation industry," Planzer said.

"We are fully committed to supporting long-term modernization efforts such as SESAR [the European Aviation Safety Agency's Single European Sky ATM Research initiative] and NextGen [the U.S. Federal Aviation Administration's Next Generation Air Transportation System] without losing sight of improvements we can make today."

Their paper contained recommendations to improve ATM efficiency, including speeding up "real-time decision making through enhanced information sharing" and minimizing restrictions on airspace use that result in inefficient operations.

U.S. National Aeronautics and Space Administration

Changes in Melbourne

Recent changes in Flight Safety Foundation's governing structure have prompted a reorganization of the Australian Advisory Board, co-chaired by John Guselli and Geoff Dell.

Because of the abolition of the regional director's position, the advisory board is now linked to the main U.S. office through Board of Governors member Cameron Ross.

In Other News …

Projections of a doubling of U.S. airline passenger travel to 1.2 billion passengers by 2032 reinforce the need for continued progress in implementing the U.S. Federal Aviation Administration's **Next Generation Air Transportation System**, Transportation Secretary Ray LaHood says. … Raymond Benjamin has been reappointed to a second term as secretary general of the **International Civil Aviation Organization**. His new term will run through July 2015.

Compiled and edited by Linda Werfelman.

A Matter of METERS

The Falcon 900 did not overrun by much, but the damage was serious.

BY MARK LACAGNINA

As with most aircraft accidents, there were several "ifs" that might seem relatively benign when taken separately but together conspired to inflict substantial damage to a Dassault Falcon 900EX and present a hazard to the eight people aboard.

If the approach speed had been a few knots lower, if the touchdown had been a few meters shorter, if the runway had been dry and just a bit longer, if the pilots had considered a go-around a few seconds earlier, if the thrust reverser system had not malfunctioned, or if the concrete base for an approach light had not protruded from the ground off the end of the runway, the overrun accident at Germany's Emden Aerodrome the morning of Nov. 18, 2009, might not have happened.

But it did happen, and the events leading to the accident are discussed in the English version of the final report released in February 2012 by the German Federal Bureau of Aircraft Accident Investigation (BFU).

There were no injuries in the accident, which occurred during a business flight from Braunschweig, in north central Germany, to Emden, which is about 140 nm (259 km) northwest, near the coast of the North Sea.

The pilot-in-command (PIC), 55, had 18,500 flight hours, including about 8,500 hours in type, and held an airline transport pilot license and certification as a Falcon 900EX type rating instructor. "His most recent simulator training had taken place in June 2009," the report said.

The copilot, 27, held a commercial pilot's license and had about 3,500 flight hours, including about 420 hours in type. "His most recent simulator training had taken place in August 2009," the report said.

The flight attendant, 33, had 1,523 flight hours, all in type. "Her responsibilities were those of so-called in-flight service personnel," the report said.

Strong Gusts

Before departing from Braunschweig at 1048 local time, the flight crew received a comprehensive weather briefing. Conditions at Emden were influenced by a strong low-pressure area over the North Sea, causing "hurricane-like" gusts in the area, the report said. A warm front also had brought heavy rain to the Emden area earlier that morning.

"The weather information available was both sufficient and accurate for the flight in question and did not flag up a need for any limitations," the report said. "The weather information implied that the landing would be gusty and the runway probably wet."

As the aircraft neared Emden, the crew was told by an air traffic controller that the surface winds at the airport were from 200 degrees at 15 to 20 kt with gusts at 25 to 30 kt, visibility was 9 km (6 mi), the ceilings were broken at 1,800 ft and overcast at 2,400 ft, and Runway 25 was in use. The crew then was given radar vectors and was cleared to conduct the NDB (nondirectional beacon) approach to Runway 25.

After establishing radio contact with Emden Flight Information Service, the crew was told that the winds were from 200 degrees at 25 kt.

The airport at Emden is uncontrolled and has a single asphalt runway, 07/25, which is 1,300 m (4,265 ft) long and 30 m (98 ft) wide. "The threshold to Runway 25 is displaced by 100 m [328 ft], leaving a usable runway length of 1,200 m [3,937 ft]," the report said.

Emden Aerodrome was certified for aircraft with maximum weights below 14,000 kg (30,864 lb), but the company that operated the Falcon — which has a maximum takeoff weight of 22,226 kg (49,000 lb) and a maximum landing weight of 20,185 kg (44,500 lb) — had received an exemption from the local transportation authority to operate at the airport.

Familiar With the Field

"Both pilots had previously flown to the Emden airfield and were familiar with the local infrastructure and the relatively short runway," the report said. "There were no local limitations in force, and the full 1,200 m of runway were available for the landing."

The Falcon's actual landing weight was about 14,420 kg (31,790 lb), and the calculated landing reference speed (V_{REF}) was 116 kt. The crew added 12 kt to V_{REF} for the wind conditions, resulting in a planned approach speed of 128 kt with full flaps and slats.

The airplane flight manual indicated that, for the aircraft weight and configuration, the required dry-runway landing distance was 745 m (2,444 ft) and the required wet-runway distance was 857 m (2,812 ft).

The report noted, however, that because

The nose landing gear struck the concrete base of an approach light.

Photos: © German Federal Bureau of Aircraft Accident Investigation

Falcon 900EX

Jet fighter manufacturer Avions Marcel Dassault in 1963 introduced its first business jet, the Mystère 20, later marketed as the Fan Jet Falcon and then as simply the Falcon 20. Smaller versions dubbed the Falcon 10 and 100 followed in 1973 and 1981, respectively.

The long-range, three-engine Falcon 50 was introduced in 1976, with the larger Falcon 900 and 900B models appearing in 1984 and 1991, respectively. Range was increased further when the Falcon 900EX was introduced in 1995.

Compared with previous models, the 900EX has more powerful Honeywell TFE731-60 engines, rated at 22.24 kN (5,000 lb) thrust. An additional fuel tank in the rear fuselage and a larger tank in the center fuselage increased fuel capacity to 9,526 kg (21,000 lb).

Maximum weights are 22,226 kg (49,000 lb) for takeoff and 20,185 kg (44,500 lb) for landing. At 0.8 Mach, the normal cruising speed, maximum range with reserves is 8,028 km (4,335 nm). Stall speed in landing configuration is 85 kt.

The 900EX was succeeded by the winglet-equipped 900LX in 2010.

Sources: Dassault Aviation, *Jane's All the World's Aircraft*

the approach was flown faster than planned, the required landing distance actually was 986 m (3,235 ft).

The crew told investigators that despite the strong and gusty winds, the approach was stable, and they established visual contact with the runway while descending through 1,700 ft about 6 nm (11 km) from the airport. They completed the "Final" checklist, which included a test of the anti-skid braking system and hydraulic indicators. "The crew said that both were normal," the report said. They selected autobrake position 1, which corresponds to normal anti-skid braking.

"Witnesses stated that the runway was wet [and that] there were a number of large puddles on the left and right outer margins in the final quarter of the runway," the report said. "The last 200 m [656 ft] of the runway had a large puddle left of the centerline."

'Very Late' Touchdown

Calibrated airspeed was about 132 kt when the aircraft crossed the runway threshold, and the report noted that the PIC did not reduce thrust to idle to reduce the touchdown speed.

The Falcon touched down about 214 m (702 ft) from the threshold at 1126. "Given that the runway is short … even under ideal conditions, this was very late to brake the aircraft to a full stop on the runway," the report said.

Recorded flight data indicated that calibrated airspeed was 124 kt and groundspeed was 115 kt on touchdown. The copilot engaged the airbrake while the PIC reduced thrust on all three engines to idle and then advanced the thrust reverse lever. The report noted that the latter action was not in keeping with standard operating procedure, which requires the pilot to ensure that the "DEPLOYED" annunciator has illuminated before applying maximum reverse thrust.

Moreover, the thrust reverse system, which is on the center engine, did not function normally. With all three wheels on the ground and the thrust levers at idle, the thrust reverse lever should remain locked, keeping thrust at idle, until the reverser doors on the center engine deploy fully; then, the reverse lever is unlocked and can be advanced to increase the exhaust flow impacting the doors and being redirected forward for reverse thrust.

Investigators found that the mechanical lock was substantially worn, allowing the thrust reverse lever to be advanced before the reverser doors were fully deployed. "During the landing, the thrust reverser doors remained in a partway position between stowed and deployed," the report said. "Since the engine was already delivering high power, the doors were unable to attain the deployed condition."

Thus, the thrust reverse "DEPLOYED" annunciator never illuminated; instead, a master caution was generated to warn that the doors had not fully deployed.

'No, Too Late'

About eight seconds after touchdown, the PIC called for a go-around. "This call came too late for a safe go-around," the report said. "At this time, there was about 550 m [1,804 ft] of runway remaining, the flaps were set to 40 degrees, and the reverse thrust was delivering full power."

The pilots recognized this. Shortly after calling for a go-around, the PIC said, "No, too late." The copilot agreed, saying, "No, no more."

The aircraft was about 320 m (1,050 ft) from the departure end of the runway when the PIC disengaged the thrust reverse system. The report said that although maximum reverse thrust normally can be used until the aircraft is at a standstill, the PIC's decision to disengage the system was correct because the malfunction actually had resulted in some forward thrust being produced by the center engine. "During the investigation, it was not possible to determine the strength of the respective thrust component in each direction," the report said.

After the PIC disengaged the thrust reverse system, three seconds elapsed as the thrust produced by the center engine decreased from 82 percent to 36 percent N_1 (fan speed). The aircraft then began to decelerate more rapidly.

"During the following seconds, the flight crew attempted to brake the aircraft to a stop from a [calibrated airspeed] of about 95 kt (80 kt groundspeed)," the report said. "After having traveled about 900 m [2,953 ft] along the runway, the crew steered the aircraft toward the right. They said it was their intention to avoid a collision with the runway lights located on the grass just after the hard runway."

Groundspeed was about 15 kt when the Falcon overran the runway. The nose landing gear collapsed and separated from the airframe after striking the base of the approach light, the farthest to the right among seven lights located 2.4 m (7.9 ft) from the end of the runway. "Both main landing gear were still on the runway, the left gear about 1.5 m [4.9 ft] in front of the runway end," the report said.

Groundspeed was about 15 kt when the Falcon overran the runway.

After the Falcon came to a stop, the PIC told the flight attendant, "Open the door. Open the door. Get everyone out." The flight attendant unlatched the cabin door and lowered it, but the door opened only about halfway before coming into contact with the ground. "In this position, the stairs were presented as a line of triangles with the apex directed upward," the report said, noting that although this likely hindered the evacuation, everyone was able to exit quickly through the opening.

The report concluded that the causal factors of the accident were:

- "The extended landing distance due to the [fact that the] increased approach speed was not taken into account;
- "The aircraft touched down too late on the runway;
- "Consideration of a go-around came too late for action;
- "The go-around was not carried out;
- "The engine thrust was reduced too late; [and,]
- "A faulty reverse thrust mechanism partly negated the effect of wheel brake operation, thereby extending the landing distance."

This article is based on the English translation of Investigation Report BFU CX015-09. The report is available in German and English at <www.bfu-web.de>.

© Chris Sorensen Photography

breaking the ICE jam

Directive targets frozen controls in Citations.

BY MARK LACAGNINA

Reacting to recurring incidents involving Cessna 560XL rudder jamming, the U.S. Federal Aviation Administration (FAA) has issued an airworthiness directive (AD) requiring modifications to reduce the amount of water that can accumulate in the aft fuselage and freeze on the rudder control cables and pulleys.

Effective April 25, the AD, 2012-06-01, applies to about 475 Cessna 560XLs — the Citation Excel, XLS and XLS+ — registered in the United States. It requires, in part, the installation of water drain holes and air seals in the "tailcone stingers" — the aftmost portion of the fuselage, beneath the empennage — within 12 months or 800 flight hours, whichever comes first.

The directive is the latest in a series of actions dating back to April 2005, when Cessna began drilling drain holes in the bottom of the tailcone stingers on production airplanes and issued a service letter, SL560XL-53-05, recommending that owners of existing 560XLs do the same.

One of the first indications that the fix was not successful came about five years later. On Dec. 1, 2010, a pilot was unable to move the rudder pedals when he attempted to initiate a crosswind correction while landing at Toledo, Ohio. No damage or injuries occurred, but differential thrust and wheel braking had to be used to taxi the airplane to the ramp. During an external inspection of the airplane, the pilot tried to move the rudder by hand, but it would not budge. Maintenance personnel found ice in the tailcone stinger, and further examination by an FAA inspector revealed that although a drain hole had been incorporated per the service letter, it was smaller than specified. The inspector examined other 560XLs in a maintenance hangar at Toledo and found three that also had drain holes smaller than specified by SL560XL-53-05.

Twelve days later, on Dec. 13, 2010, a flight crew found that rudder control was "unusually stiff" after disengaging the autopilot and yaw damper on final approach to Birmingham, Alabama. As in the Toledo incident, the airplane was landed without further event, and the crew had to use the brakes to steer the business jet to the ramp. Investigators for the U.S. National Transportation Safety Board (NTSB) found another similarity: Both airplanes had been parked outside in the rain before the incident flights and had encountered freezing temperatures en route. Unlike the Toledo incident, however, the Birmingham airplane had a drain hole that met the dimension specified by the service letter.

During the investigation, NTSB also found that a similar incident had occurred at Idaho Falls, Idaho, on Dec. 20, 2010.

The incidents prompted Cessna to issue an alert service letter, ASL560XL-53-08, on Jan. 21, 2011, advising owners to seal the hole prescribed by the initial service letter and to drill two new drain holes — in the forward stinger bulkhead and in the tailcone frame forward of the stinger.

NTSB recommended that an AD be issued to mandate compliance with the alert service letter, but the FAA cited evidence that the specified modifications had not solved the problem. Foremost, there had been another incident, this time involving a 560XL that had been modified according to the ASL. The airplane was en route from Baltimore to the Bahamas on March 10, 2011 — after having been on a ramp in moderate rain for 1.5 hours — and was climbing through 29,000 ft when the pilot flying noticed that the yaw damper was not functioning normally. After disengaging the yaw damper and the autopilot, he exercised the flight controls and found that the rudder was jammed. The crew decided to divert to Myrtle Beach, South Carolina. "Descending through 13,000 ft, normal rudder operation returned, and the subsequent approach and landing [at Myrtle Beach] were uneventful," the NTSB report said. After parking the airplane, the pilots saw water dripping from the airplane; further inspection revealed ice in the bottom of the tailcone stinger.

Modifications include seals to reduce the amount of water and air entering the tailcone, and holes to improve drainage.

In its response to NTSB, the FAA also noted that it had participated with Cessna in test-flying an ASL-compliant airplane equipped with video cameras in the tailcone stinger. The tests showed in part that air could enter through seams in the bottom of the stinger and through one of the drain holes with enough velocity to splatter water onto the rudder pulleys and cables. Only after building up in a large quantity would water overcome the air flowing into the drain hole and exit the stinger. The FAA told NTSB that the investigation was continuing and that several design changes were being considered.

NTSB classified the FAA's response as "acceptable" and stated that the recommendation would remain open until further action was taken. That action came on Oct. 4, 2011, when Cessna issued a service bulletin, SB560XL-53-16, introducing "additional modifications to reduce the amount of moisture that can enter the tailcone stinger and improve drainage."

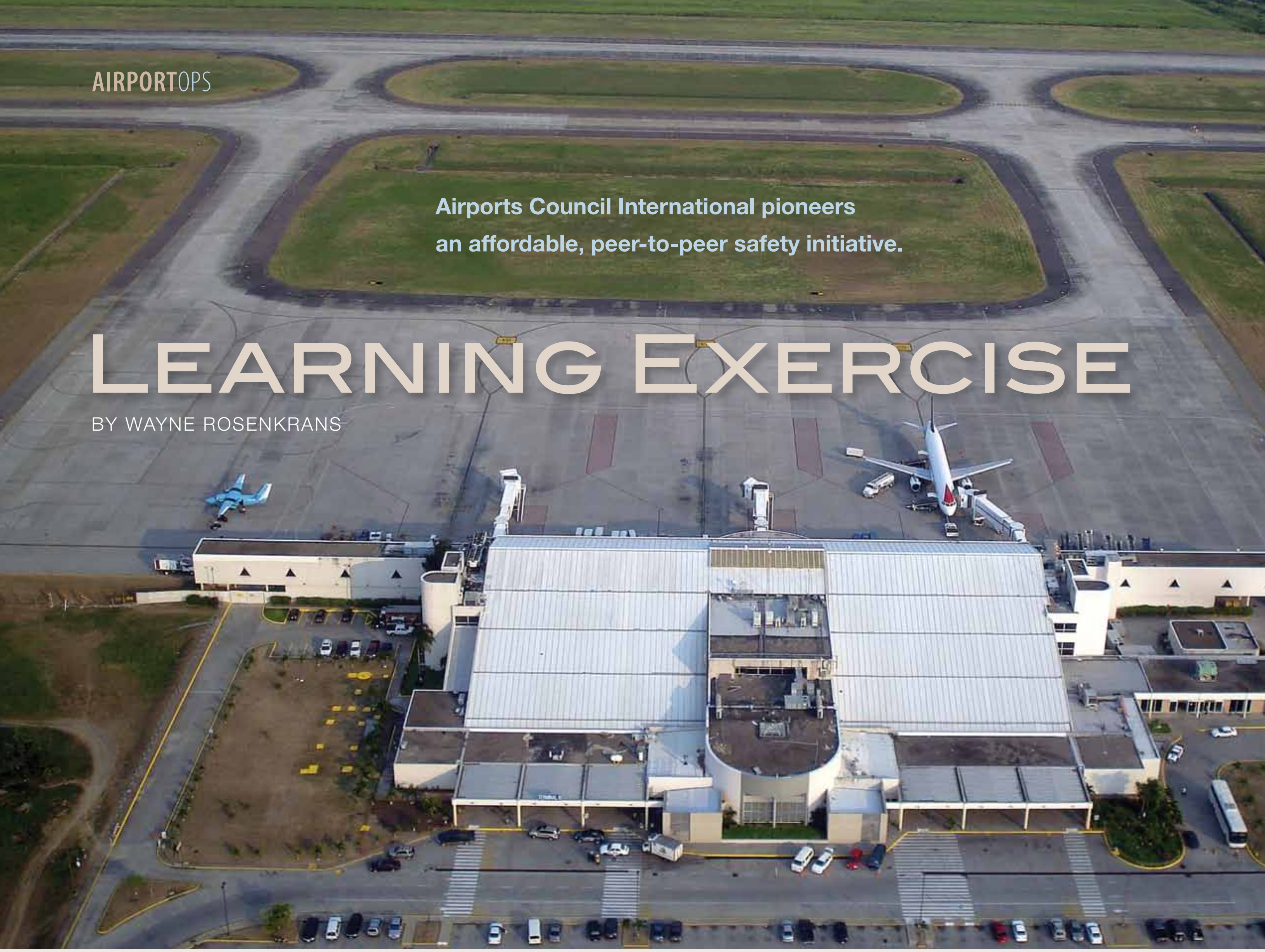
The FAA followed up in December with a proposal to mandate compliance with Cessna's service bulletin, as well as the earlier alert service letter where applicable. The agency explained that while parked or during ground operations in rain, a 560XL can accumulate a large amount of water that pools in the lowest point of the stinger. "This water sprays onto the rudder bias cables and pulley due to the inflow of air into the stinger," it said. "Therefore, as the airplane climbs to temperatures below 32 degrees F, the water freezes on the cables, pulleys and mounting brackets. The ice acts as an adhesive, which prevents the pulleys from rotating and the cables from sliding on the pulleys."

NTSB has told FAA that although it believes the airworthiness directive will "accomplish the desired safety result," Cessna 560XL owners should modify their airplanes before the allotted 12 months or 800 flight hours. "Accomplishing the AD in the shortest time frame is appropriate, given that the loss of rudder authority may go undetected until the moment it is needed."

Airports Council International pioneers an affordable, peer-to-peer safety initiative.

Learning Exercise

BY WAYNE ROSENKRANS



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Early indications show an unprecedented nonprofit, peer-to-peer collaboration among the world's airports making solid progress toward enhanced runway safety and the mitigation of airport-related risks. In a March update briefing for *AeroSafety World,* Airports Council International (ACI) recalled how its member airports unanimously voted in November 2010 to launch the Airport Excellence in Safety (APEX) initiative.

At that time, ACI World, the organization's headquarters in Montreal, envisioned that APEX would rest on pillars of "documentation, training and mutual assistance based on a strong airport-to-airport mentoring program," with runway safety as the top priority. The APEX reference document says, "According to the International Civil Aviation Organization [ICAO] Universal Safety Oversight Audit Program [USOAP] … of the total number of states audited, 70 percent did not establish or implement a runway safety program to prevent runway incursions; 44 percent failed to implement the ICAO standards regarding the certification of aerodromes; 50 percent [did] not require periodic testing and review of aerodrome emergency plans or the measurement of friction characteristics; [and] 38 percent [did] not ensure that aerodrome operators comply with the requirements related to operational services and physical facilities. … We will be working closely with ICAO … particularly to analyze key safety performance indicators [that] will enable the program to identify high risk states and aerodromes, and for each [ACI] region to then put appropriate measures in place to ensure that the identified risks are mitigated."[1]

Since a 12-month pilot phase of APEX began in September 2011, ACI World and five ACI regional offices have been refining airport safety review methods and preparing to launch the operational phase in 2013, said Adrian Cioranu, project manager, APEX, at ACI World. "The airport safety review is just an enabler, not the purpose of APEX," he said, explaining that the

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A daily team brief for the ACI APEX airport safety review in San Pedro Sula, Honduras, included specialists from APEX, Honduras CAA, ACI World and ICAO Regional Office - Mexico.

initiative essentially enables airport professionals to get together and to help each other. "APEX volunteers know they have just days to accomplish something that has to be extremely valuable to an airport."

Airport safety reviews have been conducted at Société Aéroportuaire de Lomé-Tokoin, Lomé, Togo (September 2011); Aeropuerto Internacional Ramón Villeda Morales, San Pedro Sula, Honduras (February 2012); and Aeroporto Internacional de Maputo, Maputo, Mozambique (March 2012). Further 2012 safety reviews in the pilot phase were scheduled for April at Kenneth Kaunda International Airport in Lusaka, Zambia, and for April–May at Soekarno-Hatta International Airport in Jakarta, Indonesia. "We are now considering one or two pilot safety reviews in Europe, and one more could be in North America," Cioranu said.

As of early 2012, the safety partners on three teams requested by host airports have been ACI – Africa; ACI – Latin America and Caribbean; ACI World and ACI regional offices; Aerodom Siglo XXI; Airports Company South Africa (ACSA); Corporación Quiport; Geneva International Airport, Switzerland; ICAO Regional Office – Dakar; ICAO Regional Office – Mexico; and Office National des Aéroports, Morocco.

Some safety partners have reported positive results to Cioranu. "I had a great experience working in San Pedro Sula with the team," said Juan Manuel Manríquez Viñas, corporate manager of operational safety and certification, Aerodom Siglo XXI. "We had the opportunity to create a balance, sharing all of our field and office experience. Having an ICAO regional officer–aerodromes on our team, mixed with ACI members and aerodrome operators, created a perfect match to perceive each item from all points of view."

ACI World also is in discussions with 10 more airports and state governments in Africa, Latin America and Asia Pacific regions about possible memorandums of understanding for the fourth quarter of 2012 and 2013. The length of each safety review is nominally one week, but may extend to about two weeks depending on the size of the airport and the complexity of its operations.

The pilot phase of APEX was launched on a non-remunerative basis, and ACI intends to continue that policy for an indeterminate period. The costs borne by the host airport generally include transportation, accommodations and meals but exclude any fees to safety partners or to ACI. "This streamlines the logistics and also helps airports to quickly gain the benefits of the program," Cioranu said. "We will have to reassess this model as we enter the operational phase, but right now, we're not considering other business models."

During the pilot phase, the effects of different operational contexts and cultural factors are being studied to guide refinements. "The team composition changes because we try to base it as much as possible on regional considerations," he said. For example, most safety partners who get involved with an APEX host airport come from "neighboring" ACI-member airports and regional offices of ACI and ICAO — from the Latin America and the Caribbean region in the case of San Pedro Sula, and from South Africa in the case of Maputo. John Pottinger, safety and operations manager, ACI World, has been the team leader during the pilot phase.

Runway Safety First

"Under APEX, runway safety is a major theme, and safety review team recommendations aim at helping the host airport to mitigate any vulnerabilities that the team notices," Cioranu said. "During the pilot phase, we have developed a standard operating procedures manual and revised the APEX reference document partly to assure sufficient monitoring of runway-related incidents and accidents, which are the most serious occurrences and have the greatest number of victims. Host airports typically need to enhance the way they capture key safety indicators and incidents via better monitoring. There is a lot of work to be done."

APEX specializes in helping host airports determine for themselves the best way forward in complying with national regulations — or ICAO standards and recommended practices if state civil aviation regulations are non-compliant — and with relevant best practices of the global airport community. Best practices, by definition, incorporate and exceed minimum regulatory requirements, Cioranu noted.

"During the on-site safety review, ACI airports gain invaluable access to best practices, and peer airport representatives learn from each other," he said. "We also focus on safety management systems [SMSs]. What matters most is for the host airport, and the people who actually work there, to be motivated to do the things necessary to make airport operation safer."

ICAO standards in *Annex 14, Aerodromes,* Volume I, "Aerodrome Design and Operations," have been the primary source of APEX safety standards; expert consensus documents such as tools from Flight Safety Foundation's runway safety initiative also have been incorporated. Cioranu said that the program wants host airports to have measures, procedures and a better understanding of standards and recommended practices, whether or not they have been incorporated into national laws and regulations.

Teams help host airports to recognize the easy fixes that have been overlooked, as well as to take steps toward complex, long-term solutions to safety problems. For example, they could find a host airport dealing with a state aeronautical information publication (AIP) that is out of date or nonexistent, requiring joint effort by the host airport and the civil aviation authority (CAA). "Sometimes, the CAA does not have enough people," Cioranu said. "Maybe the information needed from the host airport did not get to the right people, or maybe there was a misunderstanding of the standards." Assuming the safety partners understand the situation at the airport level and in the CAA context, solutions often can be implemented easily, he added.

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An ACI APEX runway inspection in Maputo, Mozambique, included specialists from ACSA, APEX and ACI Africa.

A team does not make any blanket statements that the host airport's operations are unsafe. "They are safe, but safety is a continuous improvement exercise — a self-evaluation," Cioranu said. "Teams have seen that these airports are willing to look at potential vulnerabilities and accept expertise and help from the outside so that operations can be even safer rather than to just struggle with finding a solution by themselves. APEX is also an extremely affordable solution for them."

Safety partners inevitably observe safety gaps at the host airport; perhaps the airport lacks adequate airport markings or a runway safety team. Merely pointing out the problem tends to accomplish very little, Cioranu said. "The APEX team tries to emphasize what can be achieved; solutions don't have to be revolutionary, they can be evolutionary," he said. "Implementing a runway safety team doesn't really cost anything, for example."

The pilot phase of APEX also has demonstrated that safety partners' structured analysis of SMS can have surprising results. "Host airports might not realize that they already have some SMS elements in place," Cioranu said. Gaps sometimes can be filled by revising job descriptions; correcting missing, inadequate or outdated procedures; and sending the right people to ICAO and/or ACI training.

Timing of proposed solutions "depends on the seriousness of the situation encountered in the field — whether it has to be solved immediately or whether solutions can be left, say, for medium-term action," Cioranu said. "Economics play a very important role. For example, repaving a runway could be very important but not be possible to do immediately. In the short term, however, the host airport should ensure that operations remain safe — not just patch the problem indefinitely — and when funding becomes available, fully solve the problem."

ACI World is quick to distinguish the APEX initiative from familiar auditing by CAAs, ICAO, airlines and other organizations. "Our safety reviews are different from audits," Cioranu said.

"An APEX safety review only happens on request by a host airport. This way, we encourage complete openness. We perform the review confidentially, and results are shared among the host airport, ACI and ICAO. If the host airport decides to share the information beyond that, that is fine by us."

APEX also differs in each team's intense motivation to suggest practical elements of an action plan to the host airport. "The host airport says what is important and achievable in the short, medium and long run," he said.

ACI World does not consider member airports as "customers" or a "market" for APEX services per se but instead as beneficiaries. ACI membership also is not a requirement to participate in APEX but is advantageous. "The main APEX services are oriented toward ACI members, so the program definitely is for the members," Cioranu said. "If we have a request from a non-member airport, we definitely will give it consideration — provided that we have the resources and such a safety review would not be detrimental to a member, such as postponing a scheduled safety review or creating an inconvenience.

"Any airport potentially could be a beneficiary of the program. We do not focus necessarily on developing states, developed states, a specific airport size or a region; APEX is open to everybody. Under our concept, however, we may focus on specific operational contexts or issues such as runway incursions and excursions or an SMS, which is not yet in place at some airports."

Safety partners typically are selected for a team assigned to a particular mission. "We look at the ACI member airports in a region, and we contact them to see which has available a person with specific expertise and experience — for example, in aircraft rescue and firefighting," Cioranu said.

Peer-to-Peer Advantages

The idea behind airport professionals exchanging safety knowledge and experience with their counterparts at other airports has several facets. "Peer-to-peer definitely means mutual respect and welcoming external assistance," Cioranu said. ACI members might assume that sharing experiences in APEX is a one-way process, from safety partners to the host airport, but that has been disproved during the pilot phase. "It may be counterintuitive, but when the safety partners go home, they realize they have received great value and benefit — that this was a learning exercise for everybody. Looking beyond the processes at their own airport was like 'thinking outside the box.'"

Ongoing mentoring also is planned. Such a relationship developed when ACSA invited people from Maputo to receive further training in South Africa and began considering further exchanges, he noted.

So far, ACI World has been able to accommodate every airport seeking APEX services, although not necessarily for specific dates requested. "We're now treating every request on a first-come, first-served basis unless there's a specific reason why an airport's request would need to be given higher priority," he said.

Because APEX processes were set up to move from the airport-request stage to the final-report stage within 16 weeks, any airport facing an acute safety issue should be able to receive timely assistance after APEX has completed the pilot phase. Procedures in that event would include consultation with ICAO in evaluating the urgency and defining the mission.

Also envisioned are scenarios in which a state requests APEX safety reviews of multiple airports at or around the same time. This scenario aligns with the APEX intent to encourage former host airports to take turns as safety partners within their state. "It makes perfect sense to have people coming from other airports to attend a safety review in the same state to gain the methodology, knowledge and access to a pool of experts," Cioranu said.

The final report produced after a safety review is important. But relatively speaking, this step is a formality compared with the APEX exit debriefing and the immediate steps taken by the host airport to begin implementing its action plan. "The debriefing involves the senior management at the host airport, and whoever else they deem necessary," Cioranu said. "Whatever the final report says will have been known from the debriefing."

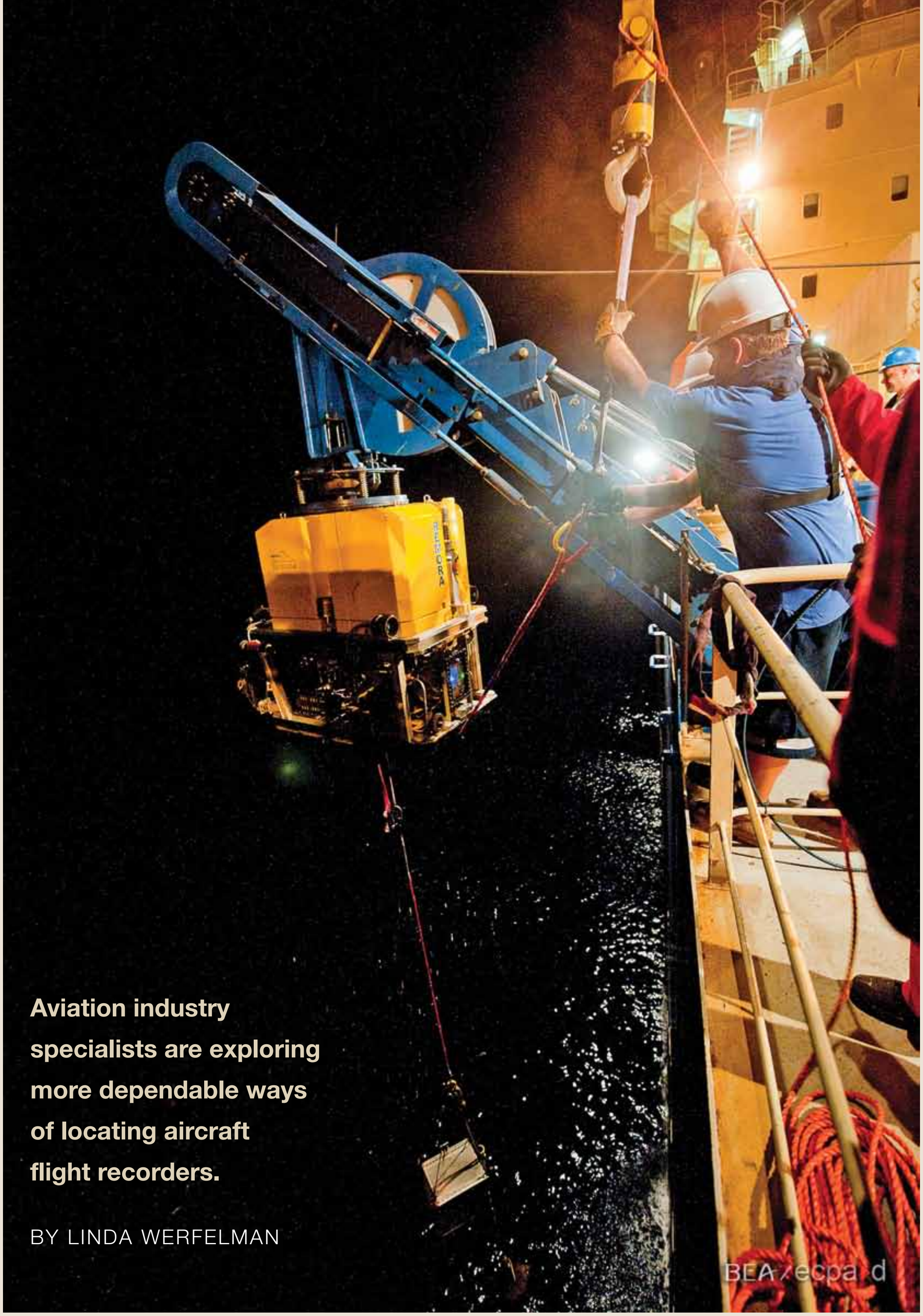
After the final report has been delivered, APEX will be open to requests for less-intensive on-site visits by a few safety partners who can lend support to implementation of the host airport's action plan.

ACI | APEX™ AIRPORT EXCELLENCE IN SAFETY

Note

1. ACI World. *APEX Reference Document.* Version 1.2, Feb. 2, 2012. The data are from USOAP 2009 results, ACI said.

Narrowing the Search



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Aviation industry specialists are exploring more dependable ways of locating aircraft flight recorders.

BY LINDA WERFELMAN

In the nearly three years since an Air France Airbus A330 crashed into the Atlantic Ocean and searchers began a 22-month hunt for the airplane's flight recorders, alternatives have developed to make future searches more efficient or, in some cases, to provide new methods of delivering crucial flight information to accident investigators.

Some of these alternatives involve various uses of streaming data; others focus on new methods of locating an aircraft's black boxes under water or in other difficult terrain.

In the aftermath of the June 1, 2009, crash, regulators have pressed for changes even as the French Bureau d'Enquêtes et d'Analyses (BEA) has continued its investigation into the cause of the accident, which killed all 228 people aboard the flight from Rio de Janeiro, Brazil, to Paris. The BEA has said that its final report would be published by June.[1]

An investigation also was continuing into another accident four weeks later in which a two-month search was required to locate the flight recorders — the June 30, 2009, crash in the Indian Ocean of a Yemenia Airways A310 is under investigation by authorities in Comoros.[2]

The lengthy investigation of the Air France crash has led the BEA to issue a number of safety recommendations, including several involving flight recorders and the transmission of flight data. One of these recommendations calls on regulatory authorities — specifically the International Civil Aviation Organization (ICAO) and the European Aviation Safety Agency (EASA) — to "make mandatory as quickly as possible, for airplanes making public transport flights with passengers over maritime or remote areas, triggering of data transmission to facilitate localization as soon as an emergency situation is detected on board."

A BEA working group studying triggered transmission of flight data noted in a 2011 report that systems exist to accomplish that goal.[3] Some would go further, transmitting more than that minimal amount of data.

"Developing reliable emergency detection criteria is achievable," the report said, citing its study of accidents, incidents and normal flights, which found that "criteria based on a limited set of recorded flight parameters can detect 100 percent of these accidents and incidents."

The flight data recorder of an Air France A330 is pulled from the Atlantic Ocean in May 2011, nearly two years after the airplane crashed during a transoceanic flight. Below, sailors from the Brazilian navy recover wreckage after the June 2009 accident.

© Brazilian Air Force/Associated Press

The report added, "The concept of triggering the transmission of flight data consists of detecting, using flight parameters, [when] an emergency situation is upcoming. If so, transmitting data automatically from the aircraft until either the emergency situation ends or the aircraft impacts the surface."

The report cited several examples of existing systems that transmit data automatically from an aircraft to a ground station for purposes of maintenance or monitoring.

On-Demand Triggered Streaming

Among them is AeroMechanical Services' FLYHTStream, which provides on-demand triggered data streaming, including flight data recorder information and aircraft position information based on global positioning system (GPS) data. The information can be obtained from aircraft operating anywhere in the world.[4]

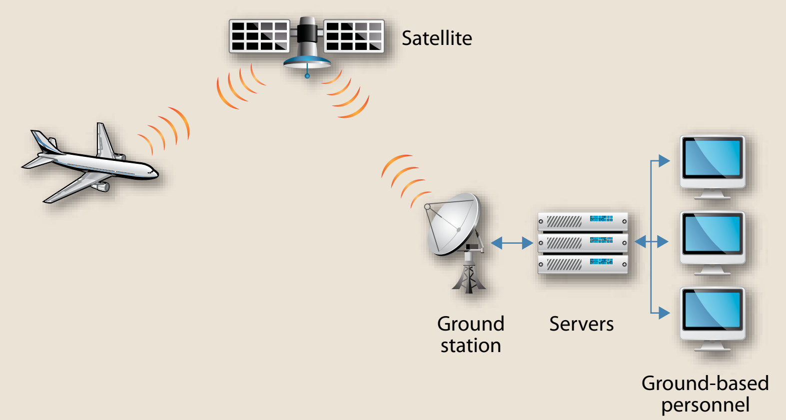
FLYHTStream can be activated in one of three ways — automatically, when predetermined criteria are met; by a pilot; or by personnel on the ground — and transmits information via Iridium satellites to air traffic control, search and rescue, ground stations, and others, including subject matter experts (Figure 1, p. 28).

"The real-time streaming of critical flight data to the ground creates a virtual black box, allowing the data to be analyzed immediately," the company says. The system automatically notifies key personnel — through urgent emails, text messages or visual/audible notifications on a variety of software systems — and enables communication between pilots and personnel on the ground.

"This … eliminates the chance of key personnel being unaware of an emergency due to misinterpreted maintenance messages that may not indicate the severity of the incident," the company said. "With immediate event reporting and position tracking, it is possible to enhance the provision of appropriate procedures and resources to improve [search and rescue] reaction times."

This type of data streaming is critical, the company said, for "building situational awareness of an airborne event in progress, or for

Data Streaming



Source: Lumumba/iStockphoto and Susan Reed

Figure 1

post-flight analysis in cases where the FDR [flight data recorder] cannot be recovered."

Real-Time Data Transmission

Star Navigation Systems Group and Astrium Services, a unit of the European Aeronautic Defence and Space Co. (EADS), have developed a satellite communications data service — Airborne Data Service (ADS) — which also provides for real-time flight data transmission to aircraft operators.[5]

ADS uses on-board processors that analyze parameters of actual flight performance and compare them with expected parameters.

"The service uses in-flight equipment that also compresses, encrypts and then securely transmits the data via satellite to Astrium ground stations, which then relay this information to airline operators, enabling in-flight visibility of performance from ground-based facilities," Star Navigation said.

The service provides more information than the more traditional aircraft communications addressing and reporting system (ACARS), which was in use on the Air France A330 and which transmitted a position message and about two dozen maintenance messages during the last five minutes of the flight. The messages "show inconsistency between the measured speeds, as well as the associated consequences," the BEA said in its first interim report on the accident.[6]

The ACARS messages by themselves did not present a complete picture of what happened in the last minutes of the flight.

Both Airbus and Boeing airplanes have onboard systems that monitor and collect maintenance data, then transmit the information via ACARS so that it can be analyzed by maintenance personnel on the ground.

BEA interim accident reports characterized the Airbus Centralized Maintenance System as a tool designed to generate maintenance reports during and after flight "to help airline maintenance departments to anticipate unscheduled maintenance events and to make decisions in the frame of troubleshooting."[7]

Boeing's Airplane Health Management (AHM) uses "real-time airplane data to provide enhanced fault forwarding, troubleshooting and historical fix information to reduce schedule interruptions and increase maintenance and operational efficiency," the BEA said.

The BEA noted that AHM was installed in a UPS 747-400 that crashed Sept. 3, 2010, in Dubai and that it "successfully sent data while the aircraft was still in flight prior to the crash." The accident, which killed both flight crewmembers — the only people aboard — and destroyed the airplane, is still under investigation.[8]

Another system — ECT Industries' Data Transmission System (DTS) and Brite Saver, described as an on-board tracking and data-transmission system that uses the Iridium satellite network — was operating in a Eurocopter AS350 B3 that crashed Oct. 28, 2010, in Antarctica, the BEA said. The wreckage was found 500 m (1,641 ft) from the last position transmitted by DTS. All four people in the helicopter, which operated from a French research vessel, were killed and the helicopter was destroyed.[9]

Underwater Locating Devices

The Air France accident investigation "brings to light the difficulties that can be encountered in localizing, recovering and reading out the recorders after an accident in the sea," the BEA said.

To address those difficulties, the BEA issued other safety recommendations along with an interim accident investigation report made public in late 2009, calling on regulatory authorities, specifically EASA and ICAO, to "extend as rapidly as possible to 90 days the regulatory transmission time for ULBs [underwater locator beacons, sometimes referred to as underwater locating devices (ULDs)] installed on flight recorders on airplanes performing public transport flights over maritime areas." Currently, ULBs must transmit for at least 30 days.

A companion recommendation, also designed to make it easier for searchers to detect the ULB signal, called on regulators to require the installation of an additional ULB on airplanes involved in public transport flights over maritime areas.

An ICAO panel reviewed those recommendations and related issues and late in 2011 compiled a series of recommendations of its own, based on "a combination of advances in aircraft systems and flight recorder technology, in addition to lessons learned from recent accident investigations," including the investigation of the Air France crash.[10]

Earlier this year, ICAO said it was accepting the recommendations of its Flight Recorder Panel to propose an amendment to Annex 6 — *Operation of Aircraft* calling for 90-day ULB transmissions and installation of additional beacons.

The U.S. Federal Aviation Administration (FAA) also is preparing to implement a change that will extend the minimum required operating life of ULDs to 90 days. The FAA said in a published notice in March that it planned to make the change by March 1, 2014.[11]

ICAO also proposed an amendment to Annex 6 calling for alternate power sources for recorders that would activate automatically to operate a cockpit voice recorder (CVR) for 10 minutes after the CVR's normal power supply is interrupted.

Another proposal would require the use of lightweight recorder systems in smaller helicopters engaged in commercial operations. The amendment was proposed because of the "lack of sufficient data for the investigation of accidents of smaller helicopters involved in commercial operations," ICAO said.

The ICAO Triggered Transmission of Flight Data Working Group continues to review the concept of triggered transmission of flight data, as well as continuous data streaming, to aid accident investigation or help in locating black boxes. The working group was considering not only systems that would result in better use of regular aircraft position reporting through ACARS messages but also through the use of automatic dependent surveillance–contract.[12]

Another subject that remains under discussion within ICAO involves the use of deployable flight recorders, which have been used for years by military aircraft and which have been considered as a way of retrieving aircraft data when wreckage is difficult to access (*ASW*, 8/09, p. 24).

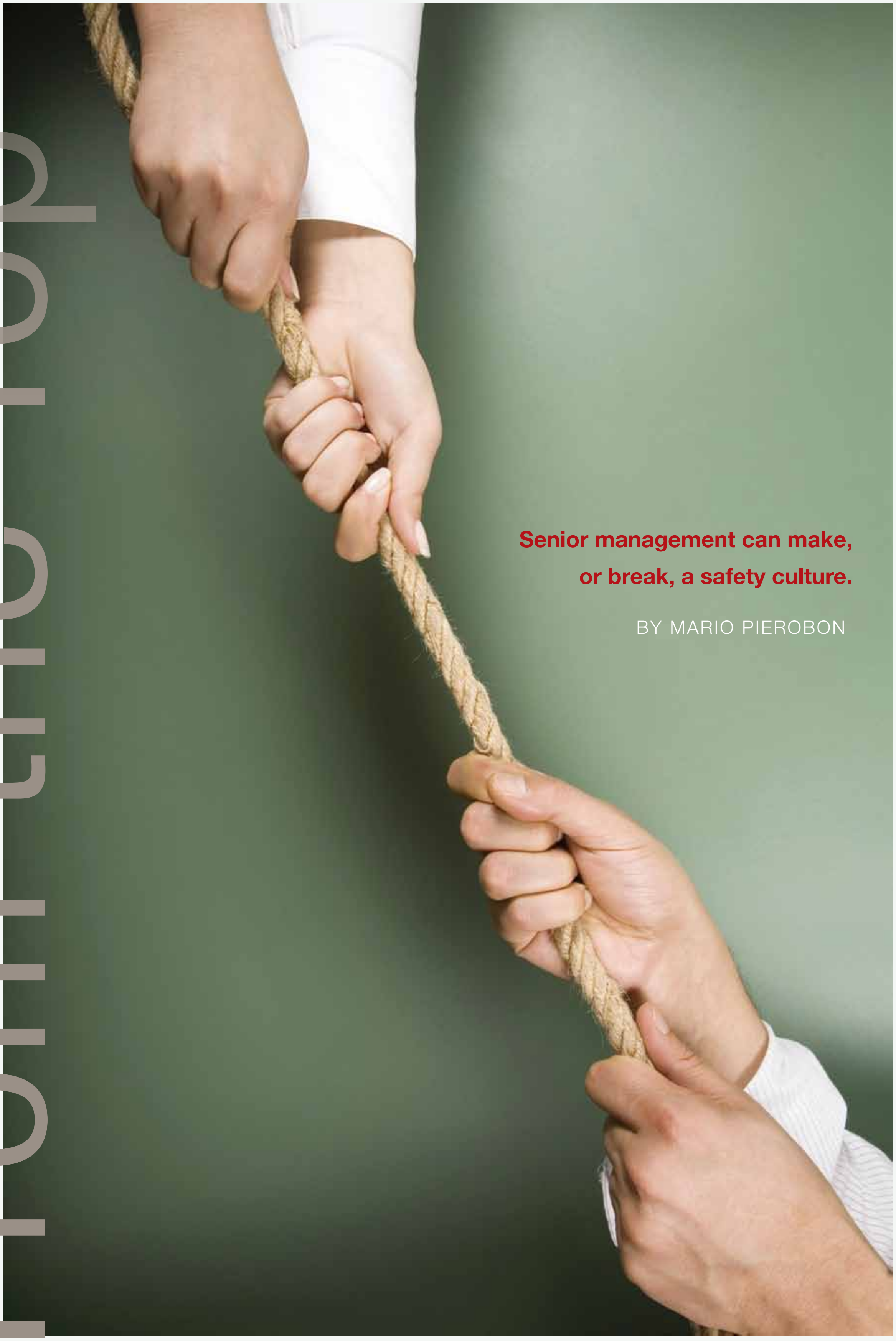
"If an aircraft enters an attitude which is typically unrecoverable, the deployable recorder would be ejected," ICAO said. "The emergency locator beacon would activate to transmit the position of the recorder, and therefore the wreckage, whether on land or at sea. The flight data and cockpit voice recordings would be available as soon as the deployable recorder was recovered."

Deployable recorders were developed in response to concerns voiced in the 1960s by the National Research Council of Canada, which wanted a better way to locate aircraft that crashed in remote areas.

Notes

1. The BEA has said in preliminary reports that in the final minutes of the flight, the airplane's airspeed indications were incorrect, "likely following the obstruction of the pitot probes in an ice crystal environment," and its automatic systems were disconnected. "The airplane's flight path was not brought under control by the two copilots, who were rejoined shortly after by the captain," the third preliminary report said. "The airplane went into a stall that lasted until the impact with the sea."
2. The Yemenia A310-300 crashed off the coast of the Comoros Islands after a flight from Yemen and sank in water up to 4,000 ft deep. All but one of the 153 people passengers and crewmembers were killed, and the airplane was destroyed.
3. BEA Triggered Transmission of Flight Data Working Group. *Technical Document*. March 18, 2011.
4. AeroMechanical Services. *FLYHTStream*. <flyht.com>.
5. Star Navigation. "Star Navigation and Astrium Services Announce Joint Agreement to Provide Airborne Data Services." June 22, 2011.
6. BEA. *Interim Report*, f-cp090601ae. <bea.aero/en/enquetes/flight.af.447/flight.af.447.php>.
7. BEA Triggered Transmission of Flight Data Working Group.
8. Aviation Safety Network (ASN). Accident Investigation. Preliminary–Official. 03 Sep 2010.
9. ASN. ASN Wikibase Occurrence No. 78943.
10. ICAO. *2011 State of Global Aviation Safety*. Montreal. 2011.
11. FAA. "Underwater Locating Devices (Acoustic) (Self-Powered)." *Federal Register* Volume 77 (March 5, 2012): 13174–13175.
12. The FAA defines ADS–C as "a data-link position reporting system, controlled by a ground station, that establishes contracts with an aircraft's avionics that occur automatically whenever specific events occur, or specific time intervals are reached."

From the Top



Senior management can make, or break, a safety culture.

BY MARIO PIEROBON

© Kutay Tanir/iStockphoto

Many aviation professionals remember Eastern Air Lines Flight 855, a Lockheed L-1011 that lost all three engines due to the omission of oil seals in the master chip detector assemblies. In today's era of the safety management system (SMS), the May 5, 1983, accident still yields important lessons about the key safety role played by senior management.

The L-1011 was en route with 10 crewmembers and 162 passengers from Miami to Nassau, Bahamas, when the no. 2 engine's low oil pressure warning light illuminated. The flight crew shut down the engine, and, due to worsening weather conditions at Nassau, the captain decided to return to Miami. On the way, the low oil pressure lights for no. 1 and no. 3 illuminated, and both engines subsequently flamed out. The airplane descended without power to about 4,000 ft, where the crew was able to restart no. 2. The airplane was landed at Miami with only that engine operating. No one was hurt, but the engines had been damaged because of the loss of lubrication.

The U.S. National Transportation Safety Board (NTSB) determined that the accident had resulted from "the failure of mechanics to follow the established and proper procedures for the installation of master chip detectors in the engine lubrication system, the repeated failure of supervisory personnel to require mechanics to comply strictly with the prescribed procedures and the failure of Eastern Air Lines management to assess adequately the significance of similar previous occurrences and to act effectively to institute corrective action."[1]

As this accident demonstrates, decisions made by senior management have very important implications for a company's safety performance. Senior aviation managers have the responsibility for embedding positive safety cultures in their organizations. This involves the provision of adequate resources and guidance in SMS implementation.

'A Matter of Time'

The International Civil Aviation Organization (ICAO) says that senior management sometimes faces the *dilemma of the two Ps*, which arises "because of the perception that resources must be allocated on an either/or basis to what are believed to be conflicting goals: production (delivery of services) and protection (safety)."[2]

"In cases when such competition develops, protection is usually the loser, with organizations privileging production objectives," ICAO said. "Inevitably, such partial organizational decision making leads to catastrophe. It is simply a matter of time."

"There has to be a conscious effort to ensure that objectives are not competing," says Nancy Rockbrune, assistant director of safety and fatigue risk management systems at the International Air Transport Association (IATA), "For example, on-time performance should be pursued, [but] not at the cost of ground damage and/or employee injuries."

It is ultimately senior management that must properly address the dilemma of the two Ps. Because it has the most decision making power in the distribution of organizational resources, senior management has an eminent role in providing adequate resources for safety management.

Among key resources are policies for effective risk assessment. Senior management should ensure that people are trained accordingly and that accountability/responsibility and authority are clear. Moreover, appropriate action must follow risk assessment.

The importance of well-executed risk assessment is illustrated by the Sept. 23, 1999, overrun at Bangkok, Thailand, by Qantas Flight 15, a Boeing 747-400. The runway was wet, but braking action had been reported as good, and the 747 crew elected to use the company's preferred procedure of landing with flaps 25 and idle reverse thrust.

The Australian Transport Safety Bureau (ATSB) found that this procedure had not undergone proper risk assessment before it was introduced three years earlier to cut costs of brake and thrust reverser maintenance, and noise levies.[3] Although the company emphasized that the previous standard procedure of using flaps 30 and full reverse thrust should still be used in certain conditions, such as for contaminated runways, it did not define what constitutes a "contaminated" runway or provide flight crews with associated procedures or training to evaluate the effects of runway conditions on aircraft landing performance.

Other factors, such as the captain's cancellation of the first officer's (the pilot flying's) decision to go around, were involved in the accident, which substantially damaged the 747 but caused no serious injuries to the 410 people aboard. However, ATSB said that the overrun would not have occurred if the crew had used the flaps 30/full reverse thrust procedure.

Performance-Based

Establishing an effective SMS involves a shift to performance-based safety management. This means that each organization manages safety according to its unique operations, safety performance and safety needs. There is no such thing as an "out of the box"

SMS that works for every organization. Executives must create the appropriate environment for the capture of relevant safety information, the identification and analysis of risks, and the determination of mitigation actions.

Embedding a positive, or just, safety culture within the organization is key in the shift to performance-based safety management. People need to feel confident that they can report safety deficiencies without retribution and that due action will follow their reports.

The ideal safety culture is characterized by openness and demonstrated support. In its guidance for SMS development, Transport Canada said, "Senior management should be accessible and dedicated to making the changes necessary to enhance safety. They should be available to discuss emerging trends and safety issues identified through the system."[4]

Moreover, a positive safety culture recognizes that "errors will be made and that it is not the apportionment of blame that will resolve the problems," the U.K. Civil Aviation Authority (CAA) said.[5]

Management should create an environment that encourages open reporting, seeks to learn from its failures and is just in dealing with those involved. Punitive action must not automatically follow the open acknowledgement of human error. However, as the U.K. CAA noted, it must be made clear that indemnity will not be guaranteed if there has been gross negligence and willful disregard.

Demonstrated Leadership

An SMS will work only if senior management sets the example and demonstrates its leadership in proactive and performance-based safety management. ICAO affirms that "the safety ethos of an organization is established from the outset by the extent to which senior management accepts accountability for safe operations and for dealing with emerging safety concerns."

Similarly, Transport Canada recommends that senior management foster the SMS by "setting personal examples in day-to-day work to demonstrate unmistakably that the organization's commitment to safety is real, and not merely lip service, by clearly and firmly discouraging any actions that could send a contrary message."

Demonstrated leadership inevitably leads to the successful attainment of organizational safety goals. "Our company safety culture, like our business culture, comprises the same elements of strong leadership, the right structure and action focused clearly on core values and critical operating tasks," said William O. McCabe, former director of DuPont Aviation. "When all members of the work force follow such leadership and truly feel this accountability from top to bottom, they integrate their efforts to achieve the safety goals."[6]

As McCabe indicates, implementing an SMS is indeed a top-down process, with strong guidance provided by senior management. The first task is to write the company's safety policy statement. Then, and most important, says Rockbrune, senior management must live up to it, ensuring that the safety policy is perceived as relevant throughout the organization.

According to Transport Canada, accountable executives must agree, approve, promote and periodically review the safety policy for continuing applicability. Senior management also has to communicate the safety policy to all employees and ensure that they are aware of their safety obligations.

Planning for Improvement

Another key to effective safety management is a safety improvement plan, which describes "how a company will achieve its corporate safety objectives and targets, and how it will meet any new or revised safety requirements, regulatory or otherwise," the U.K. CAA said. "Significant items in the safety plan will normally be included in the corporate business plan. A safety plan … details the actions to be taken, by whom and in what time scale."

With a mature and effective SMS, executives have a full understanding of their companies' safety performance. "In a mature SMS, executives provide SMS guidance out of familiarity with safety KPIs. They are acutely aware of how their organization is performing with regards to safety and what needs to be done," Rockbrune said.

Mario Pierobon, who worked in safety performance management at IATA, recently earned a master of science degree in air transport management at City University London. This article is based on a paper submitted in conjunction with his studies.

Notes

1. NTSB Aircraft Accident Report AAR-84-04.
2. ICAO. *Safety Management Manual*. Doc 9859 AN/474, 2nd Edition, 2009.
3. ATSB Investigation Report 199904538.
4. Transport Canada Advisory Circular 107-001. *Guidance on Safety Management Systems Development*. 2008.
5. U.K. CAA Civil Aviation Publication 712. *Safety Management Systems for Air Transport Operations*. 2002.
6. Flight Safety Foundation. "Unlocking the Potential of a Safety Management System." *Flight Safety Digest* Volume 24 (November–December 2005).

Save Your Changes

Advance review of procedural change implications helps make sure they work for, not against, safety.

BY BART J. CROTTY

Changes involving an operator's policy, procedure, manual, service bulletin, airworthiness directive, checklist, placard, etc., intended for safety improvement, could paradoxically result in an unintended, dormant hazard. It's amazing how far-reaching even seemingly minor changes can be throughout an organization.

A later operating event might trigger a situation leading to a human or organizational error and an aircraft accident or serious incident. The root cause is "the devil in the detail" — a problem with planning, documentation, paperwork or implementation of the change.

Managers, the operator's decision makers, may not possess the skill, intuition and discipline to fully think through the consequences of changes. This is especially the case if they haven't investigated accidents and incidents or are not naturally prone to think outside the box. Airlines and large operators usually have staff to handle changes. But the small operator's chief pilot/owner has many functional or administrative "hats" to wear besides flying, and this leaves little time to adequately manage change — a basic management responsibility.

The best way to defend against faulty change management becoming Reason's "Swiss cheese holes"[1] is to engage another qualified person or two in a change review process. This should be kept simple. The reviewers should brainstorm and come up with a list of areas affected by the proposed change and identify actions that might need attention and revision. These might involve training, manuals, parts inventory, worksheets, tools, checklists, weight-and-balance, maintenance schedules, security safeguards, etc.

An added plus is that change review participants, being in on the front-end activity, will likely champion the change when it's implemented and influence coworkers to adopt its practice and spirit.

The review process shouldn't be complicated, and any further actions due for follow-up should be recorded. A few times through the process will develop a good starting list of possible impact areas to consider.

If something slips through the change review process, then employees — now aware of the increased management safety focus on changes — will be more alert for any neglected areas and provide constructive feedback. This would be a perfect example of a safety culture and a learning organization at work.

Civil aviation regulations don't require operators to have a management system or written procedures for change control. However, these practices could be the foundation of an industry best practice, particularly for small operators.

"Change is not made without inconvenience, even from the worse to the better," said Robert Hooker in the 16th century. An operator's change review process can ensure that the intended safety or security gains occur and do not lead to latent risks for future flight operations.

Bart J. Crotty is a consultant on airworthiness, flight operations, maintenance, aviation safety and security, and a writer based in Springfield, Virginia, U.S.

Note

1. James Reason in the 1990s coined the "Swiss cheese" metaphor in modeling the breakdown of defenses, barriers and safeguards that creates latent failures leading to accidents.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to Frank Jackman, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA or jackman@flightsafety.org.

Voluntary use of ADS-B transmitters on U.S. airport ground vehicles will reduce risks.

Maximum **Visibility**

BY WAYNE ROSENKRANS

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Over time, planners of the Next Generation Air Transportation System (NextGen) for the United States expect situational awareness of all airport surface activity to be shared widely. The key safety objective is enabling controllers and pilots to reduce the risk of collisions in an airport's designated movement area by observing and reacting to the same display of aircraft/vehicle trajectories. New details from the Federal Aviation Administration (FAA) in early April show how the pieces will fit into place.

Guidance recently published in an FAA advisory circular (AC)[1] targeting airport operators and other stakeholder groups explains how they can provide a critical element. Voluntarily equipping airport ground vehicles with automatic dependent surveillance–broadcast (ADS-B) transmitters is the optimal technology — in the long run — to accurately observe and identify surface vehicles in the movement area, the AC says. The agency expects the first FAA-approved transmitter to be announced around the end of April and continues to assess eligibility for FAA funding assistance.

"Using this AC, airports will be able to acquire approved and authorized airport ground vehicle ADS-B squitter units[2] [which the FAA also calls *surface vehicle ADS-B transmitters*] that are compliant with [U.S. Federal Aviation] Regulations Part 91, *Automatic Dependent Surveillance-Broadcast (ADS–B) Out Performance Requirements to Support Air Traffic Control (ATC) Service,* as well as the initial set of ADS-B applications," the AC said. "The inclusion of airport vehicles into the surface surveillance picture gives air traffic controllers and operators one more way to identify traffic issues, understand the most efficient way to proceed on the airport surface, and avoid incursions." The FAA expects the entire network of ADS-B ground stations to be operational nationwide by the end of 2013.

Accurate and timely data for surveillance of every aircraft and ground vehicle operating in airport movement areas will be "crucial" to NextGen, says Robert Nichols, implementation lead for the FAA Surveillance and Broadcast Services (SBS) program office. "The surface environment has been very difficult to monitor due to multipath of radio frequency transmissions from the myriad of reflective surfaces on an airport, making it difficult to get the best picture," he said.

© Saab Sensis

All U.S. surface vehicles (facing page), unlike aircraft equipped with ADS-B Out, automatically silence their ADS-B datalink outside the movement area. Above, outside the United States, a Saab Sensis VeeLo NextGen vehicle locator transmits its position in the 1090 ES format.

The AC has been designed to ensure proper operation of surface vehicle ADS-B transmitters, which typically are small, self-contained devices attached to the exterior of a vehicle. Use of this AC is mandatory for several categories of airport operators. "While such units are not currently required, the FAA strongly encourages airport operators to voluntarily equip appropriate vehicles [to enhance safety and situational awareness]," the AC says. "The ADS-B system provides aircraft/vehicle position information using data provided by the unit's GPS [global positioning system] navigation system and transmitted via [one of two designated radio frequencies]. … The system converts that position into a unique digital code and transmits it, along with a unique identification code, to locate and identify the exact aircraft/vehicle."

Layering surveillance techniques has proven to be the best, though an imperfect, solution to overcome the inherent physical challenge of radio frequency reflections, Nichols said. Essentially, layering combines the respective strengths of airport-surveillance radar, airport surface movement radar, multilateration (triangulation of position from timing the arrival of conventional or ADS-B transponder signals at four or more antenna positions) and ADS-B.

"The primary locations for installation of ADS-B squitters on vehicles are 35 [airport surface detection equipment, model X (ASDE-X)] airports and the nine airports scheduled to receive [airport surface surveillance capability (ASSC)] upgrades[3] to their ASDE-3 systems," the AC said. "ASDE-X and ASSC systems are needed to receive the ADS-B squitter signals for use on ATC displays. … In the future, the FAA may deploy ASSC or ADS-B surface surveillance volumes to additional airports that could then be appropriate sites for equipage of vehicles with ADS-B squitters."

The multilateration "layer" is being expanded at these airports to process 978-MHz universal access transceiver (978 UAT) signals from aircraft and, potentially, vehicles that otherwise could be invisible to controllers or to automated incursion-alerting systems. Multilateration also derives the position of vehicles from legacy transponders and Mode S 1090-MHz extended squitter (1090 ES), while the surveillance systems extract GPS data from ADS-B signal data.

Another major advantage of fusing the ADS-B data with ASDE-X is overcoming problems involving weather-related effects on radio and radar transmissions. "The radar component of the ASDE-X and ASSC systems can detect aircraft and vehicles in and around the airport operational area without the use of airport ground vehicle ADS-B squitter units," the AC said. "However, during periods of heavy and sustained precipitation, the precipitation may attenuate the radar, thus reducing the probability of vehicle detection. In these cases, vehicles equipped with … ADS-B squitter units can be tracked by … ADS-B [messages] and multilateration [using only the ADS-B radio signal itself] — thus increasing the accuracy and probability of detection. … Data fusion … systems also can alert controllers to potential conflicts so they can take appropriate action to prevent surface incidents."

The self-contained ERA Squid unit atop a German airport vehicle transmits GPS-derived position and identity using ADS-B 1090-MHz Mode S.

Vehicle Policy Breakthrough

After the fundamental issue of aircraft surveillance in NextGen was settled — requiring equipage with ADS-B Out by 2020 as now specified by regulation — the FAA turned attention to alternatives in airport vehicle surveillance. "We took a hard look at how to address vehicles," Nichols said. "We already had vehicle transponder units out there that were fairly inexpensive." Historically, the legacy transponders were not expected to provide a high level of performance. Researchers and NextGen designers understood the value of equipping vehicles to maximize their visibility, however.

"As NextGen matured, the ADS-B specialists at the FAA started to work on rule making, recognizing that cockpit display of traffic information [CDTI, such as a GPS moving-map display or multifunction display] would enable pilots not only to see other ADS-B-equipped aircraft but, potentially, transponder-equipped ground vehicles," Nichols said. "However, the unresolved issue was confidence in the original transponder units. We wanted high confidence in the accuracy, and the navigation and surveillance integrity levels, to ensure that vehicles would be depicted where they actually are on the surface. That was not the case with the old transponder units, and the FAA's regulatory specialists said, 'We've got to get rid of these because aircraft pilots will see this information and potentially will react to bad information. We must limit or eliminate that risk to the greatest extent possible.'"

The FAA made the "difficult" policy decision that, going forward, airports that voluntarily equip vehicles for the movement area operation would have to procure technology that meets or exceeds the technical specifications of aircraft ADS-B units, he said. "To achieve rule-compliant accuracy and integrity values, we had to go up a level because the surface is a more stringent environment," Nichols


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said. "Vehicle units need a GPS engine consistent with rule-compliant avionics, which is a cost driver for the units because this is a higher level than used in legacy units."

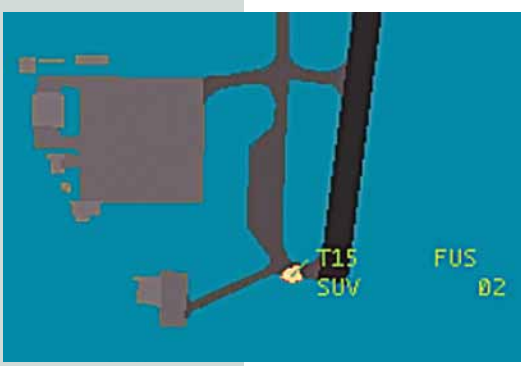
Currently, Boston Logan International Airport is the key site for the FAA. So far in 2012, the FAA technical center has conducted bench tests and on-site tests for 12 prototype, surface vehicle ADS-B transmitters. The first model slated to be approved uses 978 UAT.

"We are at a point where these units are compliant to our rules and our specification," Nichols said, noting that as of early April, agency engineers were finalizing their study of one nuance unrelated to compliance with specifications. "We needed to look at this nuance to understand it, but my goal is to have a unit identified as qualified and placed on the AC list by the end of April. Once that is announced, any airport in the country that wants to buy ground vehicle squitter units will have the option to buy this qualified product."

Each time a new unit qualifies, the FAA will update the AC list by an administrative change and announce the update on FAA websites for airports. Concerning any onboard capability for airfield drivers to share the display of surface traffic, the current U.S. technical specification for ADS-B-equipped airport ground vehicles "addresses the broadcast of ADS-B [data] only (the reception and display of ADS-B data in the vehicle is not addressed)," the AC said. Outside the United States, a number of surface vehicle ADS-B transmitters using 1090 ES have been approved and introduced at airports in several countries, but these are not compliant with U.S. specifications, Nichols said.

The FAA is considering the option of allowing its Airport Improvement Program (AIP) to provide funding assistance to airports. "I estimate a $5,000–$7,500 range per unit," Nichols said. Economies of scale also likely will reduce the cost to airports over time, he noted.

An ASDE-X display shows the position, movement and identity of a surface vehicle equipped with an ADS-B transmitter (T15 SUV).



Beyond Incursions

As the cornerstone of NextGen technology, ADS-B also facilitates capturing aircraft activity in the movement and non-movement areas for purposes such as networked decision-support tools that enhance passenger service, airport operating efficiency and collaborative decision making.[4]

Apart from reducing collision risk, some airport and aircraft operators may develop a favorable business case for connecting to the FAA's networked ADS-B data to deliver and display "an integrated surface picture to airport operators through an additional display capability," the AC said. "While ATC surveillance benefits are only applicable to airports that currently have ASDE-X or ASSC, airport ground vehicle squitter units may be deployed at any airport. These [other] airports could still derive benefit … through ADS-B cockpit applications and through airport operator displays."

A slight constraint on potential efficiency gains from ADS-B transmitters on vehicles — the Federal Communications Commission's restriction on where 978 UAT and 1090 ES signals can be transmitted on any airport surface — is unlikely to affect the efficiency benefits sought by airport operators and other non-FAA users, Nichols said. The reason is that tracking aircraft is their primary interest in ramp and gate areas.

ASDE-X Emphasis

As the FAA's most advanced runway incursion detection system, ASDE-X as of September 2011 became operational at the last of 35 airports in the NextGen plan. To display to air traffic controllers highly accurate, near-real time position and identification information for aircraft and vehicles in the movement area — regardless of precipitation or reduced visibility — the latest updates to ASDE-X fuse data.

Pilots of aircraft that have ADS-B In with CDTI directly receive messages enabling the display of any ADS-B-equipped vehicles in the movement area whenever they are in range. By using the FAA's traffic information service–broadcast (TIS-B), however, even vehicles out of range or not equipped with ADS-B Out — but otherwise tracked by ASDE-X — appear as readily identifiable targets on cockpit displays and on authorized non-FAA displays at airports.

"Airports without FAA-deployed surface surveillance may choose to equip their vehicles with ADS-B squitters," the AC said. "Aircraft equipped with ADS-B In avionics and CDTI will enable pilots to see ADS-B-equipped vehicles' [locations]. [Airport operators] should consider current and near-term equipage of the aircraft using their airport when deciding on investments in ADS-B vehicle squitters. … The future use of vehicle units at airports other than ASDE-X-equipped airports is not yet defined."

However, Nichols said the safety benefits even to airports without ASDE-X or ASSC should be compelling. "It's important for pilots on approach, landing or on the takeoff roll in an aircraft with CDTI to see the equipped vehicles on the surface for enhanced situational awareness." Pilots of such aircraft on approach typically will be aware of equipped aircraft and vehicles on the surface from 5 to 7 nm (9 to 13 km) along the approach path. This distance provides sufficient time for pilots to determine, for example, that a vehicle displayed in the cockpit is not stationary on the assigned runway, and to safely comply with the ATC clearance, he said.

All surface vehicle ADS-B transmitters are designed for simplicity, transmitting data only when the vehicle position is within the GPS-defined *squitter transmit area* for the specific airport. "The ADS-B equipment will contain a [squitter] transmit map that will control the unit on/off function," the AC said. In the related document, the FAA explained that "the [surface vehicle ADS-B transmitter] units must be user-friendly to allow [airfield drivers] to utilize the transmitters without extensive training and allow technicians the ability to quickly install and/or remove the units without extensive ancillary equipment, supplies or training."[5]

Strong UAT Preference

Airport operators can select either or both of the ADS-B frequency options for surface vehicle ADS-B transmitters, but the FAA advocates just one. "Due to the 1090-MHz spectrum congestion and use by numerous other systems,[6] the FAA strongly prefers the use of the [978 UAT] link," the AC said. "The extensive use of the 1090-MHz frequency has the potential to cause numerous degradations to any system using 1090 MHz."

Each airport is limited to deploying 200 total surface vehicle ADS-B transmitters, with either or both ADS-B frequencies but with a given vehicle using only one frequency at a time.

Airport operators and other authorized ADS-B adopters that take the plunge must assume responsibility for proper equipment installation in each vehicle, including the current squitter transmit maps with correct on/off boundaries, correct programming of each vehicle's unique radio call sign used in ATC communications, proper entry of the unique International Civil Aviation Organization code that also identifies each vehicle, and monitoring to ensure that units function properly at the local airport.

To read an enhanced version of this story, go to <flightsafety.org/aerosafety-world-magazine/april-2012/surface-vehicle>.

Notes

1. FAA. "Airport Ground Vehicle Automatic Dependent Surveillance – Broadcast (ADS-B) Out Squitter Equipment." Advisory Circular 150/5220-26. Nov. 14, 2011.
2. A *squitter* is an output pulse generated by the internal triggering system of an ADS-B device, as opposed to an external interrogation pulse.
3. Saab Sensis, the FAA's ASSC contractor, said in January that each of these airports will have multilateration, safety logic conflict detection and alerting software, air traffic controller working positions and recording/playback functionality. The architecture also will allow future sharing of surface movement data with approved airport systems and users.
4. FAA. "ADS-B Ground Vehicle Transmitter Compliance Testing and Monitoring Master Plan." Version 2.0, Jan. 4, 2011.
5. Airport operators or other organizations approved by the FAA to use ground vehicle ADS-B Out squitter units must obtain a Federal Communications Commission (FCC) license prior to transmitting on either frequency. Unlike aircraft, such vehicles are restricted by FCC regulations to transmitting only from the movement area. An organization approved by the FAA can apply to operate up to the per-airport maximum 200 surface vehicle ADS-B transmitters under a single FCC authorization. The FCC has granted final authorization for the FAA's preferred 978 UAT frequency on airport vehicles. A 2010 FCC waiver temporarily governs the same use of the 1090 ES frequency, pending FCC rule making.
6. The existing terminal radar secondary surveillance system, many aircraft transponders, the traffic alert and collision avoidance system (TCAS II) and several other systems use 1090 MHz.

BY LINDA WERFELMAN

Pilots need specific guidelines for deciding how much to rely on automation, an EASA official says.

© Chris Sorensen Photography

Smoothing automation's path

Modern aircraft are increasingly reliant on automation, but flight crews need more guidance to determine exactly how much automation they should use for various tasks, Michel Masson, safety action coordinator for the European Aviation Safety Agency (EASA), says.

Masson told Flight Safety Foundation's 24th European Aviation Safety Seminar — held Feb. 29–March 1 in Dublin, Ireland (see "Simple Clues," p. 45) — that EASA's automation policy is being developed as part of the European Aviation Safety Plan, a coordinated multi-year plan addressing major aviation safety concerns throughout Europe. The automation policy is based on "mapping crew-automation interaction issues, design-and-certification and training principles, and respective regulatory provisions to identify top issues and paths for improvement," said Masson, who, along with Charles Denis of EASA, authored the policy on behalf of the EASA Internal Group of Personnel Training (IGPT).

Development of the policy has been considered crucial because of pilots' reactions to the increasing role of automation, Masson said, noting that "senior pilots … may be less comfortable with automation, while the new generation of pilots may lack basic flying skills when the automation disconnects or fails or when there is a need to revert to a lower automation level, including hand flying the aircraft. …

"It is worth noticing that [EASA] is not against automation, [which is] inevitable, especially with the evolutions foreseen in SESAR and NextGen [EASA's Single European Sky Air Traffic Management Research and the U.S. Federal Aviation Administration's Next Generation Air Transportation System], but [wants to ensure] that proper mitigation measures, including regarding design and training, are encouraged to maximize benefits and minimize drawbacks."

The first step in EASA's development of an automation policy was the identification of more than 100 flight crew–automation interaction issues, which subsequently were grouped into 17 categories, including "managing the automation versus flying the aircraft," crew coordination, lack of standardization, and "complacency, over-reliance on automation [and] decision making."

The IGPT panel evaluated each of the 100 issues to determine how it might be further mitigated by design and training.

Masson noted that aircraft manufacturers' guidelines on the use of automation discuss competences that pilots must possess to make the best use of automation.

For example, a manufacturer's statement that a pilot should "select the appropriate automation level for the task and situation at hand" can be rephrased as a training objective — "pilots must be able to select the appropriate level of automation." The corresponding design objective, Masson said, is "allow/advise on selection of automation level(s) appropriate for the task and situation at hand."

In this instance, the system should provide adequate information about the selected automation level, and the flight crew should "check/monitor" the selected level, he said.

He added, "Performance of a man-machine system basically depends on design, procedures and competences, which result from education, training and experience. … Good — simple, intuitive, user-friendly — design requires fewer competences and/or procedural guidance (instructions) to be operated, and conversely … poor design requires more guidance and/or competences from the user. …

"Pointing the finger at only one element of the system in case of performance breakdown (e.g., 'pilots don't know how to fly the aircraft when the automation disconnects') is reductive and … overall system performance can be enhanced by improving any of these three basic components, individually or in combination."

Priorities

The IGPT panel then conducted risk assessments and determined the priority of each issue. The highest priority was assigned to 12 issues, including that "basic manual and cognitive flying skills tend to decline because of lack of practice and deterioration of feel for the aircraft" and "difficulties in understanding the situation and gaining/regaining control when automation reaches the limit of its operation domain and disconnects, or in case of automation failure."

Other top-priority issues included "when automation fails or disconnects, the tasks allocated to the pilots may fall beyond their capabilities," "for highly automated aircraft, problems may occur when transitioning to degraded modes (e.g., multiple failures requiring manual flight)" and "flight crew is not sufficiently informed of automation failures or malfunctions."

Also on the list were the following:

- "Pilots interacting with automation can be distracted from flying the aircraft. Selection of modes … may be given more importance than value of pitch, power, roll and yaw and so distract the flight crew … from flying the aircraft.
- "Unanticipated situations requiring pilots to manually override automation are difficult to understand and manage, create a surprise effect and induce a workload peak.
- "Diagnostic systems are limited with regard to dealing with multiple failures, with the unexpected and with situations requiring deviations from [standard operating procedures].
- "Flight crews may spend too much time trying to understand the origin/conditions/causes of an alarm, which may distract them from other priority tasks.
- "Although the situation is safety critical and the action that the flight crew must take is known, the alarm only indicates the condition met (e.g., stall) but not the action to take (e.g., push stick).
- "Data entry errors, either mistakes or typing errors committed when using electronic flight bags (EFBs), may have critical consequences. Errors may be more difficult to prevent and to detect — no system check of the consistency of the computed or entered values — as EFBs are out of the scope of type certification and there is no guarantee that they are designed in accordance with human factors standards."

'Well Defended'

Masson said that the issue-analysis process led the IGTP panel to conclude that the aviation system in Europe is "well defended against flight crew automation issues," as long as regulations and best practices are implemented. Planned regulatory changes in design certification specifications, flight crew licensing and operations will provide additional protection, he said.

Nevertheless, he added, the aviation industry should devote special attention to the top-priority issues and to IGTP proposals for improvement.

Those proposals call for revising requirements involving basic airmanship and manual flying skills, multicrew pilot license/computer-based training (MPL/CBT) requirements, the multi-crew cooperation concept and instruction requirements concerning management of automation, and recurrent training and testing requirements regarding automation management.

Other proposals call for improving operator automation policies, encouraging manufacturers and operators to develop and publish specific automation policies for individual aircraft types rather than general guidelines for all, and reviewing regulations concerning automation management and assumptions involving a flight crew's ability to take appropriate action.

Masson cited the automated cockpit guidelines discussed in the *Operators Guide to Human Factors in Aviation (OGHFA)*, developed by the Flight Safety Foundation European Advisory Committee, which characterizes a pilot's understanding of automation as "an essential personal quality that can influence safety."

OGHFA emphasizes the "integrated and coordinated use" of the autopilot/flight director, autothrottle/autothrust and flight management system.

"Higher levels of automation provide flight crews with an increasing number of options and strategies to choose for the task to be accomplished — for example, complying with air traffic control (ATC) requirements," the *OGHFA* guidelines say.

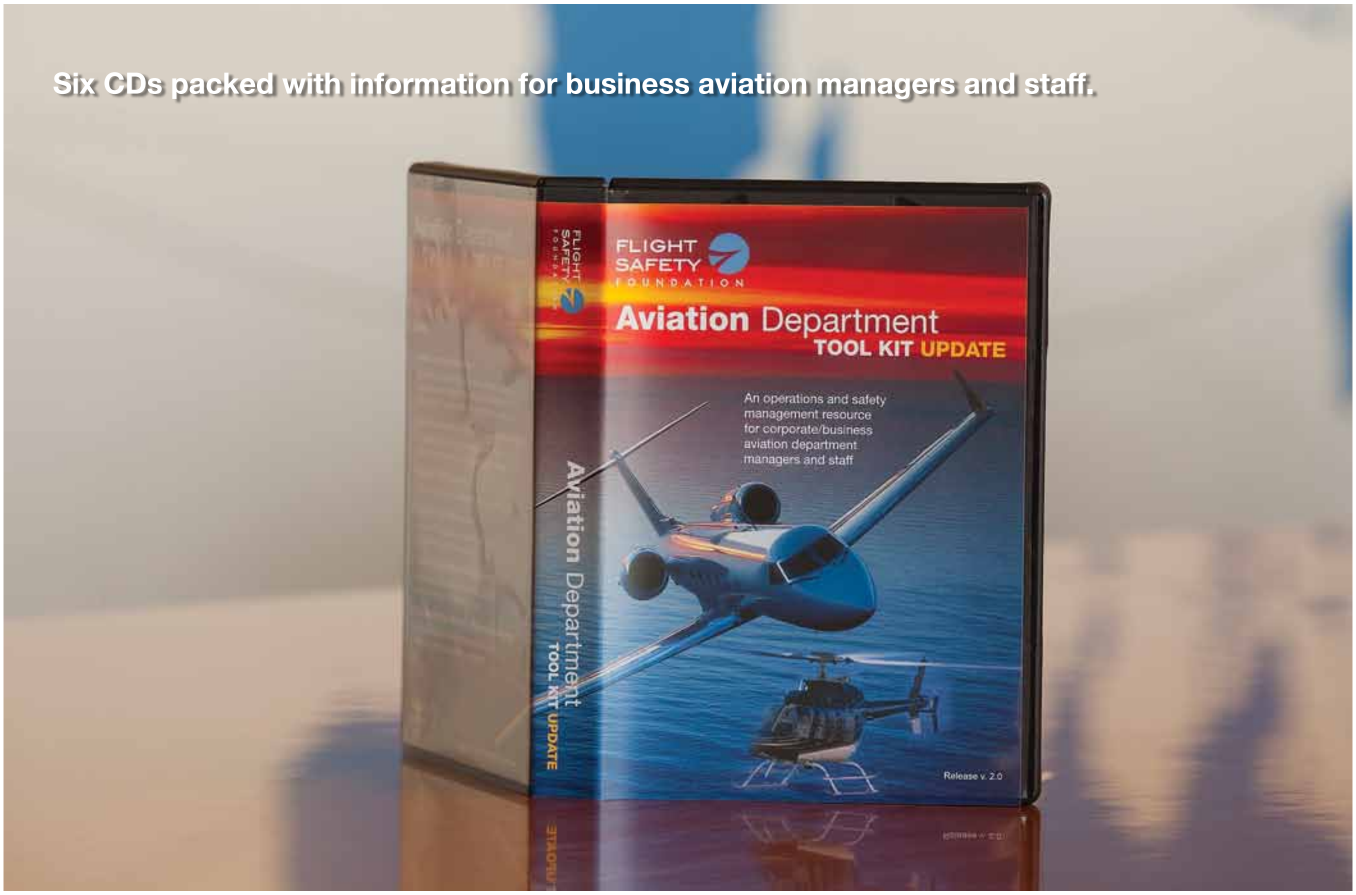
Masson also cited EASA Safety Information Bulletin (SIB) 2010-33, *Flight Deck Automation Policy — Mode Awareness and Energy State Management*, which was "prepared in a context in which air operators are requested to provide an operations manual which should contain flight procedures, one of them being related to the policy on the use of autopilot and auto-throttle in accordance with [European Commission regulations]."

The SIB recommends that operators and manufacturers work together to prepare an automation policy that addresses "philosophy, levels of automation, situational awareness, communication and coordination, verification, system and crew monitoring, and workload and system use."

The document also says that "a core philosophy of 'fly the airplane' should permeate the automation policy prepared by air operators," and that the policy should be reviewed regularly, featured in training and reinforced in all operating procedures and training programs.

Masson said the panel also recommended that authorities consider introducing requirements regarding the customization of flight deck software for electronic checklists, flight warning systems and other related items.

He said that EASA officials were planning an online survey, and possibly a workshop, to gather further suggestions for improving the agency's current policy on automation.



Wayne Rosenkrans

The Right Tools

Business aviation is among the largest and fastest-growing segments of Flight Safety Foundation (FSF) membership. Decades ago, when business aircraft operators increasingly flocked to the Foundation to bolster their safety efforts, we responded with a number of tailor-made products, including the annual Corporate Aviation Safety Seminar (CASS), recently held in partnership with the National Business Aviation Association, and operational safety audits of corporate flight departments. The auditors used to collect what they called "good ideas" — articles, videos, contacts, brochures —that informally would be handed out on a compact disc to department managers after the audits were completed.

About a decade ago, the audit staff turned to the Foundation's publications and technical specialists for help in turning the popular good-ideas CD into an organized and professional product. The result was the *Aviation Department Tool Kit*, a product comprising six unique CDs jam-packed with information and tools useful to flight department managers, chief pilots, standards pilots, line pilots, maintenance managers and mechanics, flight attendants, dispatchers — everyone in the department — in conducting their duties safely and efficiently.

As the availability of quality auditing services increased, the Foundation suspended its operational safety audits, but the tool kit arising from that effort in 2006 is still available. In fact, it was extensively revised in 2011 with updated information and new material.

Before the tool kit was published, the Foundation frequently received requests for help in creating company manuals. Accordingly, the cornerstone of the tool kit — the *Aviation Department Resources* CD — features four templates that easily can be tailored and converted into individual flight department manuals. They include the *General Operations Manual*, the *Flight Operations Manual*, the *Safety Manual* and the *Emergency Response Manual*. Each has been adapted by the Foundation, with express permission, from manuals currently being used by leading U.S. aviation departments.

The adaptation included conversion of the manuals into Microsoft Word format, to facilitate changes, deletions and additions necessary to create documents that aviation departments can call their own. The original manuals were painstakingly de-identified, which actually makes them easy to tailor by anyone with passing proficiency in using Word's search-and-replace function. For example, the oft-repeated "[company name]" can be universally replaced with a few key strokes. Ditto for bracketed, generic references to aviation department bases, aircraft types and registration numbers, personnel, telephone numbers, service providers, etc.

The *General Operations Manual* template was incorporated in the 2011 revision. The aviation department that originated this manual obviously made an exceptional effort to produce a thorough and well-thought-out document. The tool kit template comprises more than 400 pages, including appendixes. Of particular note are the sections detailing the department's safety management system and security procedures — critical areas in today's business aviation environment.

The *General Operations Manual* originated with a department that operates several turbine airplanes domestically and internationally from separate bases in the United States. The *Flight Operations Manual* template is a similar document, developed by a smaller department, but one that operates a mixed fleet of airplanes and helicopters. The *Safety Manual* and *Emergency Response Manual* templates provide even more grist for developing a master aviation department manual or separate specialized manuals, as does the *Operator's Flight Safety Handbook*, which is on a separate CD in the tool kit. The handbook is accompanied by the *Cabin Safety Compendium*, both developed under the aegis of the Global Aviation Information Network, which today is principally supported by the Foundation.

Also of note is the inclusion in the *Aviation Department Resources* CD of guidelines for duty and rest scheduling in business aviation that are still as pertinent and useful today as they were when developed in 1997 by the FSF Fatigue Countermeasures Task Force in conjunction with the National Aeronautics and Space Administration.

The cornerstone CD offers a myriad of selected presentations from CASS, business-aviation-related articles from *AeroSafety World* and previous FSF periodicals, and links to potentially useful Internet sites.

Aviation Department Resources also includes selected information and materials generated by the Foundation's approach and landing accident reduction (ALAR) project and by its runway safety initiative (RSI), but the *ALAR Tool Kit* also is in the package to provide the whole enchilada. The multimedia CD includes topical briefing notes, statistical data analyses, exhaustive reports, posters, videos, and specific guidelines and tools for preventing approach and landing accidents, and runway excursion accidents.

One of the FSF-produced videos, "CFIT Awareness and Prevention," includes chilling accounts of two controlled flight into terrain accidents involving business airplanes. One was a Beechjet that struck a hill in Georgia while maneuvering beneath a low ceiling in a non-radar environment and without a ground-proximity warning system, while awaiting an instrument clearance. The other was a Gulfstream II that struck a mountain in Malaysia during a go-around initiated because of confusion over instructions issued by a controller whose native language was not English. The accidents occurred in 1991, but the lessons learned remain remarkably pertinent today.

Another tool kit CD contains the entire 600-plus pages of the Foundation's seminal guide for business and commercial airplane operators conducting overwater flights. The CD, *Waterproof Flight Operations*, includes recommended ditching procedures, tips for purchasing life rafts and other survival equipment, advice on staying alive until help arrives, and a lot more.

Rounding out the tool kit are two multimedia presentations about recognizing and responding to critical malfunctions of turbofan and turboprop engines. Of interest to all flight crewmembers, these resources are especially valuable to pilots stepping up to turbine aircraft.

The *Aviation Department Tool Kit* is available at <flightsafety.org/store/aviation-department-tool-kit-update>.

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BY J.A. DONOGHUE | FROM DUBLIN

SIMPLE CLUES

Seminar speakers point at simple solutions for familiar risks that refuse to go away.

Pilots violating standard operating procedures (SOPs) — plus poor or missing SOPs — and pilots with inadequate flying skills are insidious problems that continue to kill many. This was the opinion of several speakers at Flight Safety Foundation's 24th European Aviation Safety Seminar in Dublin on Feb. 29–March 1.

While the world's airline community chalked up a record safety year in 2011, it was barely better than the previous high-water mark, said David Learmount, operations and safety editor, *Flight International* magazine. However, historical accident patterns persisted; "all the serious accidents, even over the past several years, have been preventable," Learmount said.

Of the 32 fatal airline accidents last year — jet and turboprop — nine happened "because the crews busted minimums on approach," he said. The five controlled flight into terrain (CFIT) accidents last year, the highest number since 2005, included "three with TAWS (terrain awareness and warning system) working; pilots will still ignore good advice."

Another eight accidents were caused "by wanton carelessness by the airline, the crew or both," he said. "Twenty-two of the remaining 32 could have been avoided … by a bit of discipline, and perhaps the other 10, as well."

A similar theme was struck by Robert Sumwalt, member of the U.S. National Transportation Safety Board (NTSB), who pointed at studies of recent accidents: "In an NTSB study of 37 crew-caused air carrier accidents, 1978–1990, procedural errors, such as not making required callouts or failing to use appropriate checklists, were found in 29 of the 37, 78 percent of the reviewed accidents." Looking at more recent accidents in the 2001–2010 period, "NTSB identified at least 86 accidents involving lack

Fatigue Strategy Mapped

Most safety innovations, after a period of development and experimentation by the industry, arrive on the doorstep of the International Civil Aviation Organization (ICAO) to be hammered into shape for uniform implementation. Such is the story for fatigue risk management systems (FRMSs), which last year got the ICAO treatment in a new document that was applicable as of this past December. Speaking at the Flight Safety Foundation's European Fatigue Risk Management Symposium in Dublin on Feb. 28, Michelle Millar, technical officer (human factors) with ICAO, said the organization approved amendments to Annex 6 Part I, to include FRMS Standards and Recommended Practices (SARPs), combining all fatigue management standards into one section, Chapter 4.

This is serious stuff, since "standards" contain the operative word "shall," meaning that regulators "must have regulations for managing fatigue based on scientific principles," either through "mandatory prescriptive regulations," more commonly known as flight and duty time limitations (FTLs), or "optional FRMS regulations," she said.

FRMS is defined as "a data-driven means of continuously monitoring and managing fatigue-related safety risks, based upon scientific principles and knowledge as well as operational experience, that aims to ensure relevant personnel are performing at adequate levels of alertness," she explained, adding that the definition implies that FRMS "is a misnomer, focusing on how alert you are, rather than how fatigued."

Millar

In the SARPs scheme — "recommended practices are 'really good ideas,'" she said — operators, "where FRMS regulations are offered, can choose how to manage their fatigue risks," she said. Operators' options include "complying with [FTLs]; or an FRMS for all operations; or an FRMS for some operations and [FTLs] for the remainder of the operations." The intent of this is that operators choosing not to use an FRMS must manage fatigue risks "within constraints of FTLs using SMS (safety management system) processes." She said that the new FRMS section of Annex 6 "is a very powerful document, designed to minimize arguments back home because we have already had these arguments" in meetings that included operators and regulators. Despite the arguments, "we are all in agreement about what is in the guidance," based on science and operator experience.

"With an FRMS, an operator continues to have flight and duty time limitations, but these are identified through their FRMS processes, are specific to a defined operational context and are continually evaluated and updated in response to their own risk assessments and the data the operator is collecting," Millar said. "It is up to the regulator to assess whether the risk assessments, mitigations and the data collected are appropriate, and that the [FTLs] identified are reasonable responses as evidenced in safety performance indicators."

Details on what SMSs and FRMSs must contain are in ICAO's Annex 8, "at the same level as a standard, and uses 'shall' language, but it provides more detail than a standard," Millar said. "Despite FRMS requiring performance-based regulation, Appendix 8 is prescriptive about just what each of the components of an FRMS has to have."

How the requirements of Appendix 8 can be put into practice is not abundantly clear, so ICAO issued two documents, *FRMS Implementation Guide for Operators* and *FRMS Manual for Regulators*. Millar noted that all of this information is available on the ICAO website but warned that some digging through the site might be needed to come up with the appropriate documents.

Recognizing the reluctance of some to adopt a FRMS, Millar said, "Over the years FRMS will evolve, and regulators and operators will become more familiar with it, and it won't be perceived as such a threat."

— JAD

of adequate procedures, policies or checklists, or lack of flight crew adherence to procedures, policies or checklists.

"To improve safety, improving procedures is a great place to focus," Sumwalt said, placing a portion of the blame on the operator: "Why aren't procedures followed? The organization lacks SOPs, doesn't adhere to its SOPs or flight crews intentionally do not follow SOPs. … Well-designed SOPs are absolutely essential to safety."

The solution starts with the organization, he said, by "making a strong commitment for procedural compliance to be a priority and a core value of the organization. Simply having the procedures is not enough; religiously following them — and insisting they be followed — must be a way of

Photos: J.A. Donoghue

doing business. Go through all manuals, checklists and procedures. Change those that don't work, are not clear, are outdated and/or are not followed. Establish a culture of compliance."

A survey showed that 50 percent of the nearly 1,000 pilots surveyed said they would deviate from SOPs if a deviation would increase safety, while 29 percent would deviate if it would not reduce safety, reported Barbara Holder, lead research scientist at Boeing. She said that 37 percent of the pilots deviated from checklist protocols once a year and 30 percent deviated several times a year. Callout requirements were ignored either every flight or in one of every 10 flights by 49 percent of respondents, and 78 percent admitted to violating stable approach criteria once or several times a year, she said.

Shifting the study focus to training, a majority — 54 percent — had a negative experience in training, with the most commonly cited problem being the simulator instructor. "If we start here," working to improve instructor selection and performance, "we can see an immediate improvement in training," Holder said.

Training also has a role in combating a new category of accidents that has developed in recent years, "black swan events" that cannot be predicted based on past experience, Learmount said. "Jets are getting more reliable and safety events are getting fewer, but when it [a black swan event] happens, it tends more to be unforeseeable."

The only possible approach to the unknowable nature of these events is enhanced piloting "resilience, a newly sought quality that comes from good, broad comprehensive training, that provides pilots with the operational and technical knowledge levels that enable them to recognize priorities when they have to deal with the unexpected," Learmount said.

Another important training process overhaul should be a move toward "evidence-based training" … an International Civil Aviation Organization (ICAO) principle, he said. "You train to a performance objective, and don't stop until that objective has been achieved. 'Not failing' an exercise does not result in a pass. There has been a loss of pilot exposure to anything other than pre-packaged flight planning, followed by automated flight."

Training, or the lack thereof, also plays a role in loss (or lack) of control (LOC) accidents, he added. "There have been 12 fatal LOC accidents since 2000; all could have been prevented, some quite easily. Unless the causes are understood and mitigating training put in place, more LOC accidents will occur."

Attacking LOC through design is difficult, as Airbus has learned with its fly-by-wire concept intended to keep the aircraft within its flight envelope. "Air France 447 [the South Atlantic A330 crash] shows that this doesn't always work," he said, and even the best LOC training won't help "because it presupposes that the crew of an aircraft that has got into an unusual or extreme attitude will have the mental capacity to recover from it."

Lagging governmental support for oversight efforts was discussed by Nicolas Rallo, ICAO's regional safety officer from the European and North Atlantic (EUR/NAT) Office. Most recent ICAO Universal Safety Oversight Audit Program examinations of civil aviation authorities (CAAs) showed problems. The world average lack of effective implementation of CAA responsibilities for qualification and training of technical staff is the most problematic, achieving only 41.1 percent of necessary levels, he said. And while CAA funding was considered to be within 58 percent of target levels globally — 60 percent for the EUR/NAT region — in judging a sufficient level of human resources, the global average of 24 percent beat the EUR/NAT results of 22 percent. And on the question of whether the CAA is a competitive employer, the world average of 46 percent beat out the 42 percent of EUR/NAT.

The reasons for the poor EUR/NAT performance, Rallo said, include discontinued positions, failure to replace departing technical staff, blocked recruitments and reductions in CAA training budgets. The basis of these problems, often in "high political levels," he said, are a lack of awareness of the consequences for the CAA, the nation and the industry; lack of understanding of the needs of civil aviation; and lack of political will.

Learmount (top) and Rallo

Another important training process overhaul should be a move toward 'evidence-based training.'

BY RICK DARBY

Four Degrees of Separation

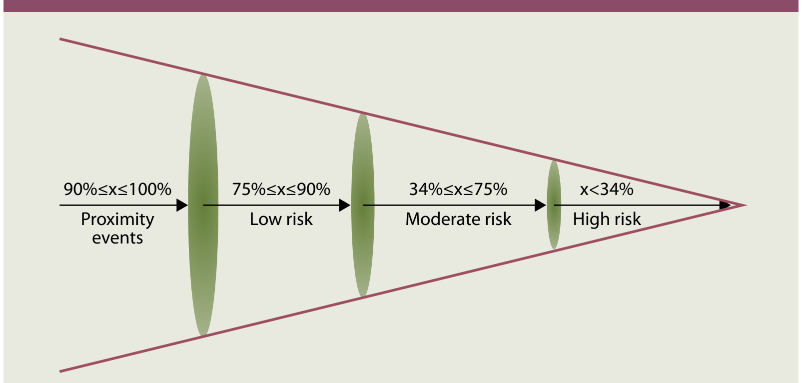
In U.S. en route operational errors, the probability of resolution increases when risk is highest.

Error containment improves as the severity of operational errors (OEs) increases, according to a U.S. Federal Aviation Administration (FAA) study of events involving U.S. en route air traffic controllers.[1] But looking at the OE data strictly by risk categories masks some error containment inefficiency.

The report describes two different studies of OEs. The first concerned the probability of resolution (POR); the second, the effects of the controller's time on position (TOP).

Study 1 was described as measuring "OE containment." The FAA Air Traffic Organization (ATO) classifies OEs into four risk categories in increasing order of severity: proximity events, in which 90 percent or greater separation is retained either horizontally or vertically; Category C, or low risk; Category B, or moderate risk; and Category A, or high risk. The ATO calculates the rates of Category B and Category A OEs to monitor progress toward safety goals.[2]

Operational Error Severity, By Separation Conformance



Note: X indicates the percentage of separation conformance (adherence to standard) observed in the operational error. For example, x < 34% means that the amount of separation conformance is less than 34%, where 100% means full separation conformance. That is, that there had been a loss of at least 66% of the total required separation. A range such as 90% ≤ X≤ 100% means that the amount of separation conformance observed in the operational error ranged between 90 and 100% of total required separation.

Source: U.S. Federal Aviation Administration

Figure 1

The report says that while existing safety metrics track error *prevention*, they do not measure *containment* of errors that occur. "The POR is a measure of the efficiency with which the NAS [National Airspace System] is able to resolve separation losses (i.e., contain the errors through the actions of controllers and pilots) before they degrade into greater risks to safety."

For the study's purpose, the risk categories were conceived as zones representing a series of points in time as air traffic separation is reduced, beginning when separation conformance[3] is less than 100 percent (Figure 1). "Thus, each of the OE safety risk categories represents a potential containment field," the report says.

In Study 1, a total of 1,293 OEs were taken from a pre-existing database for the period May 1, 2001, to May 31, 2003. "Since our primary goal in this study was to demonstrate the utility of employing a measure of OE containment for SMS [safety management system] purposes, we were not as concerned about using current OE data as we were with having a data set that we understood," the report says.

Data examined included the OE report number, the lateral and vertical distances recorded at the time of the closest proximity of aircraft, and the required lateral and vertical separation standards. Because an OE can be attributed to more than one controller, the researchers used data only for the controller who was primarily responsible, so that no OE would show up more than once.

Category C, or low-risk, OEs were most frequent in the data set, with 719 events —56 percent of the total (Figure 2). Category A — high-risk OEs — represented 15 events, or 1 percent.

The report says, "When considering the en route centers as an aggregate [Figure 3], we see that the NAS was 26 percent effective at resolving losses of separation within the proximity-event range, 75 percent effective at the low-risk range, 94 percent effective at the moderate-risk range and 100 percent effective at the high-risk range. … The distribution of PORs shows a continuous rise in efficiency as we progressed through the OE severity categories and ended with 100 percent resolution by the time we reached the Category A region."

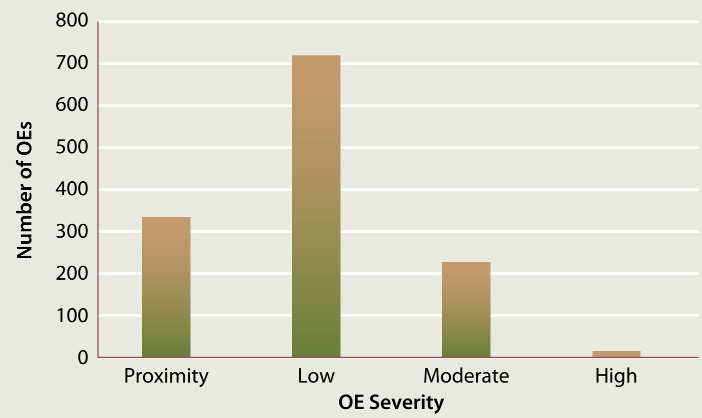
The OE categories in the original analysis did not represent equal intervals. The researchers wondered whether the same POR efficiency would be seen if the total OEs were "sliced" evenly into thinner intervals, or whether some regions of inefficiency would be evident. "Thus, we eliminated the OE severity categories and instead divided the region of separation conformance into 10 equal percentage intervals," the report says. "We then computed the number of OEs associated with each interval and calculated the corresponding PORs."

Looked at this way, the trend line for POR efficiency was no longer a smooth ascent (Figure 4, p. 50). "Whereas we saw a continuous rise in efficiency of OE containment as we progressed through the OE severity categories, we [saw] a drop in efficiency of OE containment occurring between the third and fourth interval," the report says. "A zone of relatively lower OE containment efficiency (intervals 4–6) continues until reversing at the transition between the sixth and seventh interval. This zone is primarily in the moderate OE severity (Category B) region."

It is possible only to speculate why containment efficiency declined after the third interval until recovering at the seventh, the report says: "Perhaps OEs in this region were surprises. That is, the controller may have been unaware that an OE was occurring until the separation loss crossed the 75 percent separation conformance threshold. By the time the OE was discovered, the controller did not have sufficient time to restore separation before incurring a further loss."

The report argues for use of POR data as a safety metric in addition to conventional OE data. "Looking just at the error prevention indicators, we see the number of separation losses that were resolved within each of the four OE severity categories," the report says. "However, there is a risk associated with using just these kinds of numbers.

Operational Errors, by Severity

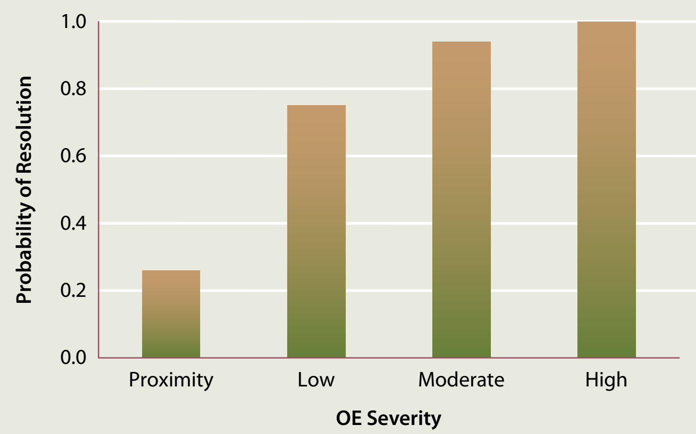


OE = operational error

Source: U.S. Federal Aviation Administration

Figure 2

Probability of Resolution, by Severity



OE = operational error

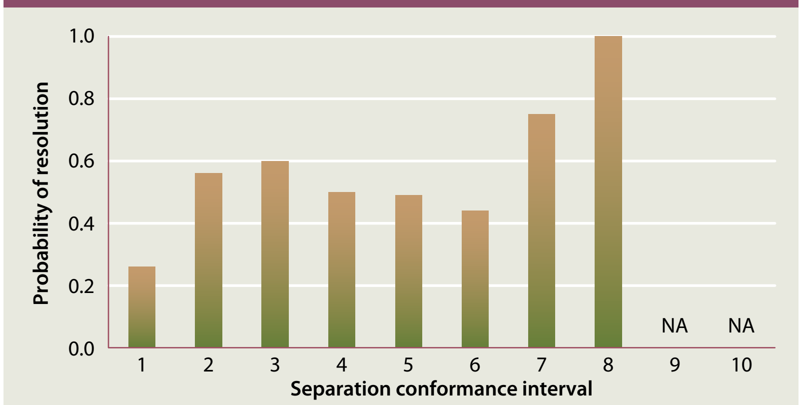
Source: U.S. Federal Aviation Administration

Figure 3

"The prevention numbers in and of themselves do not help us understand how well controllers' actions and the pilots' responses prevented (i.e., contained) an initial loss of separation from getting worse. This is what the POR captures; thus, we recommend that it be included as an additional metric for the ATO's [SMS]."

Four degrees of separation may not be enough, the report suggests: "It is important for an SMS to collect data at the finest level of detail necessary to make informed decisions. While there may be valid reasons for defining the official categories of OE severity as they are, the advantages of doing so must be weighed against [their] possible obstruction of more detailed information. Methodologically speaking, equal-interval measurements are preferred over categorical assignments and, thus, it may be advantageous for the ATO to adopt equal-separation conformance intervals both for metrics of OE prevention and containment."

Probability of OE Resolution, by Separation Conformance Interval



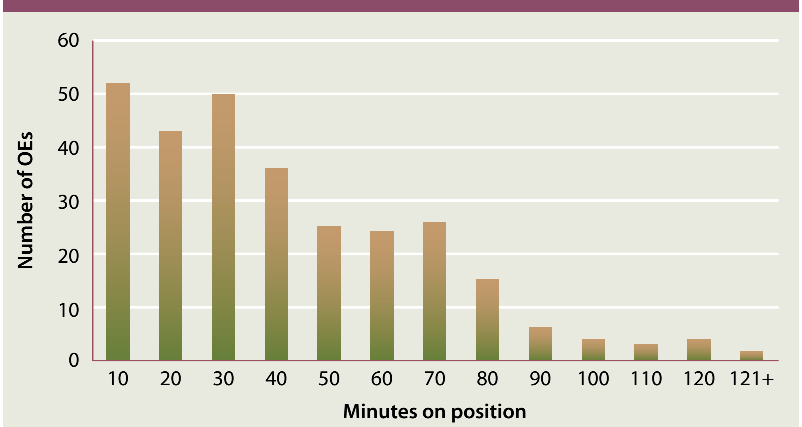
OE = operational error

Note: Separation conformance interval represents 10 equal-percentage intervals.

Source: U.S. Federal Aviation Administration

Figure 4

Annual Number of OEs, by Time on Position



OE = operational error

Note: Numbers were derived from one-year data for the six U.S. en route facilities with the greatest numbers of operational errors.

Source: U.S. Federal Aviation Administration

Figure 5

Time on Position

Study 2, of time on position, found that a higher number of OEs occurred early in a controller's TOP (Figure 5). The number of OEs was highest in the first 30 minutes of TOP.

"The trend is counterintuitive, given what is known about time on task and mental fatigue, in which lapses of attention become more likely as time on task increases," the report says. "One would expect that the longer a controller is on position, the greater the chances that mental lapses in attention would occur. However, the assumption is made that controllers coming on position must not be fully prepared to manage the traffic situation due, in part, to a faulty position relief briefing."

TOP data for U.S. en route controllers in 2006 were available to the researchers. To keep the data manageable, they were restricted to samples from the six facilities with the highest number of OEs in that year.

Researchers extracted 1,397,206 TOP records and 290 OE records. No attempt was made to account for OE severity because previous studies had failed to identify any statistically meaningful differences in OE severity based on the amount of time a controller was on position.

With data indicating the length of time controllers were on position when OEs were *not* occurring, "we were able to match these data with the length of TOP at the onset of an OE," the report says. "Together, the two data sets allowed us to calculate the probability that an OE would occur, based on the length of time a controller was on position, referred to as time on position probability (TOPP). We then used the TOPP to determine whether an exposure effect was influencing the TOP distribution of OEs."

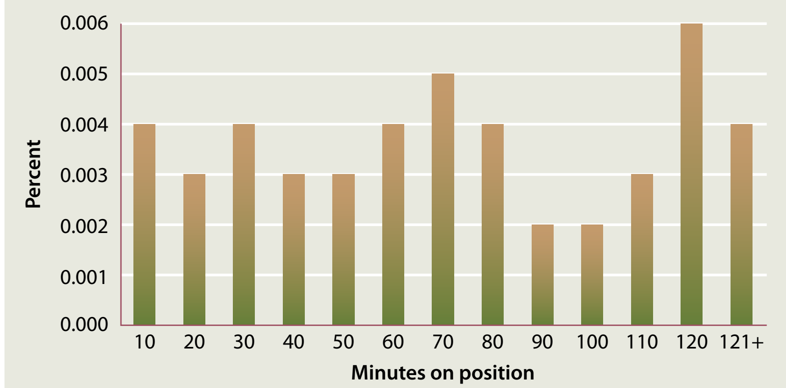
Because the number of controllers on position varied among the 10-minute intervals, counting the numbers of OEs in each interval did not measure the probability of a controller having an OE in any given interval. Therefore, "TOPPs were calculated by dividing the number of OEs that occurred during a particular 10-minute time interval by the total number of controllers who were signed on (i.e., exposed to the possibility of having an OE) during that time interval," the report says.

"When considering the [six en route] facilities as an aggregate, the TOPPs ranged from a low of 0.002 percent for the ninth and tenth intervals to a high of 0.006 percent for the twelfth interval, for an overall average TOPP of 0.004 percent, which is equivalent to four OEs out of every 100,000 [controller] sign-ons," the report says (Figure 6). "At the level of the individual, this means that, on average, a controller has a four-in-100,000 chance of having an OE each time he or she signs on to position. At the level of the [six en route facilities], this means that for every 100,000 position changes, four OEs will likely occur."

Thus, the TOPP results present a different picture from analyzing OE numbers by TOP. The report says, "The OE data suggest that the NAS is most vulnerable to OEs occurring early on position and that the vulnerability decreases with time. In contrast, the TOPP data suggest that a period of vulnerability may exist early on position, but that the vulnerability is greatest when a controller has worked longer on position. The latter interpretation is more consistent with the literature associated with time-on-task fatigue, in which the operator experiences greater mental fatigue the longer the time spent on task."

Summing up the two analyses, the report says, "The probabilities associated with OE containment and TOP are two important measures to be considered for inclusion in the [ATO's SMS]. The probability of OE containment (i.e., probability of resolution) provides a measure of effectiveness of the NAS through the actions of controllers and pilots at containing OEs at the lowest risk to safety. The time-on-position probability provides a measure of the risk of an OE occurring based on how long a controller is working on position. Both measures represent enhancements, compared to just the reporting of the frequency of OE occurrences and OE rates; thus, both measures should be considered for inclusion in the [ATO's] system of safety metrics."

Time on Position Probabilities, by Intervals



OE = operational error

Note: "Percent" is the probability of a controller committing an OE, with the distribution by 10-minute intervals of time on position. Numbers were derived from one-year data for the six U.S. en route facilities with the greatest numbers of OEs.

Source: U.S. Federal Aviation Administration

Figure 6

Notes

1. Bailey, Larry. "Analysis of En Route Operational Errors: Probability of Resolution and Time-on-Position." FAA Civil Aerospace Medical Institute. February 2012. <www.faa.gov/library/reports/medical/oamtechreports/2010s/media/201202.pdf>.

2. The report's author told Flight Safety Foundation that since the report was written, the FAA ATO has revised the way it reports and investigates operational errors. Three relevant orders, JO 7210.632, JO 7210.633 and JO 7210.634, can be found at <1.usa.gov/GWm59e>.

3. The term *separation conformance* is used because the actual required distances vary under different flight circumstances, such as altitude and proximity to airports.

Pyramid Building

Safety culture can be envisioned as a pyramid with safety values at the base.

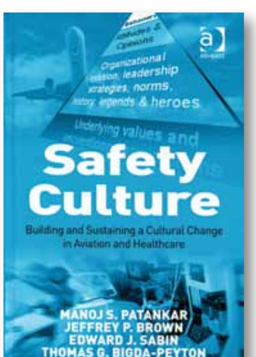
BY RICK DARBY

BOOKS

An Essential Shift

Safety Culture: Building and Sustaining a Cultural Change in Aviation and Healthcare

Patankar, Manoj S.; Brown, Jeffrey P.; Sabin, Edward J.; Bigda-Peyton, Thomas G. Farnham, Surrey, England and Burlington, Vermont, U.S.: Ashgate, 2012. 258 pp. Figures, tables, references, index.



For most of aviation history, safety progress took place on two fronts: improved technology and regulation derived from lessons learned through accident investigation. Enormous advances have resulted. But while technology and regulation still have a role, they appear to have reached a point of diminishing returns.

"In the early years of aviation, most of the accidents were attributed to unreliable technology," the authors say. "As the technical reliability improved … the complexity of challenges increased; and as the business of air travel became more complex, the improvements in technology alone were no longer sufficient to improve safety."

Similarly, they say, "The compliance-based safety culture has reached its saturation limit: further addition of regulations is not likely to produce an appreciable increase in safety. On the contrary, addition of regulations could restrict the system's ability to improvise in the face of new threats."

What will provide the next game changer in risk management? The authors, and many safety specialists, argue that the answer is evident and in some quarters already established in practice: a safety culture in aviation *organizations*. The authors say, "In the last three decades, the emphasis has shifted toward the human element — first in terms of team communication (crew resource management and maintenance resource management) and now in terms of organizational change."

Organizational safety culture, however, is a different *kind* of concept than technology and regulation. Compared with those, it is in some ways more elusive. Technology is based on application of physical laws, regulation on enforcement of written rules. Organizational safety culture is structured by principles, but ultimately is about attitudes and values that cannot be reduced to a formula.

As the authors are quick to point out, the values of a safety culture can co-exist with and ultimately benefit business management. But at the level of day-to-day decision making it may well go against traditional practices and natural human reactions. Take, for instance, the idea of a "just culture," which the authors describe as "an essential philosophical shift."

The concept can be a hard sell to managers who are paid to maximize profits. To be just to *them*, commercial aviation is a notoriously boom-and-bust business, rife with bankruptcies, and managers need to be tough-minded in pursuing profit if their companies are to survive. The authors point out, however, that "as long as organizations and legal systems use consequence of an error, rather than the underlying behavioral pattern, as the primary criterion to decide rewards and penalties, an unjust culture will prevail. At-risk behaviors tend to be rewarded when they produce positive business outcomes and penalized when they produce negative business outcomes."

The authors counsel abandoning that policy: "In the future, emphasis must be on controlling the underlying at-risk behavior regardless of the consequence of the behavior. A non-punitive error reporting system, through improved quality of work and increased productivity, is a foundational mechanism to not only improve the safety but also make a significant contribution to the financial health of the organization."

Despite the popularity of the term "safety culture," it is not always clear what such a culture includes. The book is organized around a model developed earlier by two of its authors, Patankar and Sabin, which they call the safety culture pyramid.

"At the tip of the pyramid is safety performance (or safety behaviors), followed by safety climate (or employee attitudes and opinions regarding safety); next are the safety strategies and, finally, safety values form the foundation. We present this model as a pyramid because it provides a unique way of describing the linkages across various theoretical constructs."

Safety Performance

Safety performance includes "events such as accidents, incidents and errors, as well as the individual human behaviors that may be safe or unsafe practices," the authors say. Historically, accident investigation has focused on performance problems such as "blatant disregard for established procedures, lack of training, routine preference [for] speed over accuracy and, in some cases, rewarding of risk-taking behaviors. Most such investigations focus on the behavioral aspects or factors that are readily observable and directly attributable to the accident under investigation."

They cite the report on the 1989 Air Ontario accident at Dryden, Ontario, Canada as a turning point, when "the investigators were specifically instructed to go beyond the traditional causal mapping and uncover the deeper, organizational issues. … From the perspective of the safety culture pyramid, the contributing factors are very important because they may contain information about underlying and commonly present behavioral traits and systemic opportunities that should be managed in order to improve the safety performance of the organization."

As with the other three levels, the book contains a detailed chapter considering issues implied by safety performance. One issue is whether safety performance management is reactive, proactive or predictive.

"One could consider these categories as progressive improvements or as a measure of maturity," the authors say. "Integral to this strategy is the data acquisition and analysis capability. In a reactive strategy, the undesirable event serves as the trigger and a [root cause analysis] approach is used to assemble the relevant data; however, the data tend to be focused on a specific event and on the historical trend of precursors. In a proactive strategy, safety performance data are collected as a matter of standard and routine practice, and systemic issues are addressed prior to the occurrence of an undesirable event. … In a predictive strategy, the data analysis is significantly sophisticated; multiple sources and types of data are integrated; and advanced data mining tools are used to discover unique patterns

One issue is whether safety performance management is reactive, proactive or predictive.

of coincidences that are typically difficult to identify."

Safety Climate

Safety climate consists of employee attitudes and opinions about safety. "Survey questionnaires are commonly used to measure safety climate, which is a snapshot of the sample population at the time of the survey," the authors say, noting that there are currently more than 50 safety culture/climate survey instruments.

The chapter discusses how questionnaires are developed, tested and used. The authors look at ways safety climate can be affected by interventions such as training. They describe a survey consisting of questions and discussion items for focus groups drawn from the U.S. Federal Aviation Administration Air Traffic Organization, Technical Operations. Many illustrations of the kinds of information that can be obtained through a survey are included. For example:

"Initially, most participants commented that their current safety culture was very good and needed little improvement. Their reasoning was based on a high equipment availability level. However, as the discussion continued, they acknowledged that the number of highly skilled senior staff is decreasing due to retirement, while the number of new systems to be maintained and the number of flights are increasing; the system is being stressed. The safety limits of this system are not known, but it seemed to be held together by several individuals who routinely went beyond their call of duty."

'Value-based strategies tend to be proactive and focused on the long-term goals.'

Safety Strategies

The safety strategies layer of the pyramid comprises "leadership strategies; organizational mission, values, structures and goals; processes, practices and norms; and history, legends and heroes."

Safety strategies can be broadly classified as value-based or compliance-based, the authors say. The difference is between strategies internal to the organization versus those derived from external pressures, whether regulatory- or business-generated. "In most cases, however, safety strategies are a result of a combination of the two — there's a sufficient level of readiness for change in an organization and the external pressures serve as catalysts, accelerating the adoption of the changes," the authors say. "Compliance-based strategies tend to be reactive and focused on the short-term goals; value-based strategies tend to be proactive and focused on the long-term goals."

Leadership drives safety strategies, the authors say: "Alignment across organizational mission, values, strategies, structures, processes and practices is critical in achieving a strong safety culture."

Safety Values

"Shared values and beliefs are the foundation of a culture," the authors say. "In understanding the safety culture of an organization, it is critical to delve deep into the discovery of the shared values, beliefs and unquestioned assumptions."

The enacted values of an organization — the ones actually practiced — may be at a considerable distance from those proclaimed in official statements and public relations material. The chapter discusses two methods to discover the enacted values within a group.

- "Deep dialogue" is a kind of conversation that digs beneath the surface of people's conventional and automatic responses, engaging them in "productive and reflective thinking so as to fully express the deepest beliefs and unquestioned assumptions that may be linked to their behaviors."
- "Narrative analysis" elicits "stories or experiences of employees across the organization to extract themes that can be associated with enacted values." Examples of such themes are consideration, organization and planning; timely information; and participation in decision making.

"If the enacted values don't conflict with the espoused values, there's likely to be less confusion and dissatisfaction among employees," the authors say. "[Other researchers] argue that values are owned and practiced by individuals, not organizations; individuals imprint their values on the organization. So, if there's a significant gap between the espoused and enacted values of the organization, the personal values of the leadership of the organization need to be assessed."

Besides the pyramid or "vertical" scale of safety culture, the authors propose two "horizontal scales" along which organizations can be categorized.

One is the accountability scale, whose states are "secretive," "blame," "reporting" and "just" cultures. To take the two extremes: in a secretive culture, "the organization is highly reactive, operates in a crisis mode for most events and basic resources are tied to operational metrics with extremely limited accommodation for safety issues. Therefore, when safety issues arise, resources are either cannibalized from existing operational requirements or external sources, such as insurance claims or [government] aid, need to be accessed."

In a just culture, "the people are encouraged, even rewarded, for providing essential safety-related information. In normal operations, emphasis is placed on the development of strong safety behaviors — actions, independent of their outcomes, are judged. Risk-taking behaviors are penalized, regardless of the actual loss/benefit, and risk-conscious safety behaviors are supported, even if they result in an undesirable event. Emphasis is placed on systemic investigations and solutions. Both management and employees are held accountable for safety improvements, and therefore employee-management trust is very high."

The second scale, the learning scale, involves states including "failure to learn," "incremental learning," "continuous learning" and "transformational learning." An organization stuck in a failure to learn state is "characterized by recurrence of undesirable events with similar causal contributors." Where incremental learning rules, change is typically in response to specific negative experiences, and learning behavior is directed at preventing those particular events from recurring. For example, "in the case of aircraft maintenance, the organization conducts special training regarding wheel maintenance but does not address known errors in other maintenance procedures with similar root causes."

A continuous learning organization "creates systems — structures, processes and people — that not only capture learning opportunities but also implement solutions that address broad systemic issues."

An organization in a state of transformational learning "would already have a system in place to prevent errors and be proactive in minimizing the probability of errors across the organization. Such an organization would also be recognized among its peers as one that leads in safety innovations and shares safety information freely — an organization that does not compete on safety."

In a just culture, 'the people are encouraged, even rewarded, for providing essential safety-related information.'

Crucial Ingredient?

Situational Awareness

Salas, Eduardo; Dietz, Aaron S. Farnham, Surrey, England and Burlington, Vermont, U.S.: Ashgate, 2011. 546 pp. Figures, tables, references, index.

"Research over the past three decades has demonstrated the importance of situational awareness in the safety and efficiency of flight operations," the editors say in the introduction to this massive volume. "For instance, situational awareness has been described as a crucial ingredient for proficient decision making in the cockpit. Yet a universal agreement of what situational awareness actually represents remains ambiguous and some have questioned the utility of the construct entirely."

The book consists of reprints of academic and scientific papers, divided among the following headings: "Definitions and Theoretical Perspectives"; "Methodological Issues and Approaches"; "Applications of the [Situational Awareness] Construct"; "Beyond Aviation"; and "Commentary and Review."

Garbage In, Garbage Out

Data-entry error yielded an approach speed that was too low.

BY MARK LACAGNINA

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

JETS

Stick Shaker Activated

Boeing 717-200. No damage. No injuries.

The copilot was flying the aircraft with the autopilot and autothrottle engaged on a visual approach to Runway 29 at Kalgoorlie Airport in Western Australia the morning of Oct. 13, 2010. While turning onto final approach, he noticed that the pitch limit indicator on his primary flight display (PFD), which shows the difference between the aircraft's angle-of-attack and the angle-of-attack at which the stick shaker (stall warning) activates, was "bouncing down," said the report by the Australian Transport Safety Bureau (ATSB).

At the same time, the "red zipper," a PFD indication of the margin between current airspeed and the airspeed at which the stick shaker activates, was "bouncing up." The copilot and the captain believed that turbulence, rather than an impending stall, was causing these indications.

Airspeed was decreasing below 121 kt, the calculated approach speed, when the stick shaker activated. Although the prescribed initial response is to apply maximum thrust and roll the wings level, "the copilot responded by reducing the aircraft's pitch attitude while continuing the turn," the report said. "The copilot reported that he had considered conducting an immediate go-around but continued the approach on advice from the PIC [pilot-in-command]."

The crew did initiate a go-around about a minute later, when they determined that the approach was not stabilized.

The crew had derived the 121-kt approach speed by adding the standard minimum of 5 kt to the reference landing speed (V_{REF}) of 116 kt calculated by the aircraft's flight management system (FMS). For the second approach, the crew decided to add another 5 kt to the approach speed and limit the bank angle during turns to 20 degrees.

After establishing the 717 on final approach, the copilot noticed that the aircraft was below the desired flight path, and he increased the pitch attitude. The stick shaker activated again, and the crew conducted another go-around.

Control was transferred to the captain, who conducted the third approach at 130 kt, or 14 kt above V_{REF}, and landed the aircraft without further incident.

Investigators found that the stick shaker activations during the first two approaches were primarily the result of the approach speeds, which were too low for the conditions. Before departing from Perth with 97 passengers and three cabin crewmembers earlier that morning, the flight crew inadvertently had entered the aircraft's operating weight (i.e., operational empty weight), rather than its zero fuel weight, into the FMS.

"The approach speed [116 kt] generated by the FMS was based on a landing weight that was 9,415 kg [20,757 lb] less than the aircraft's actual weight," the report said. "The data-entry error also influenced the aircraft takeoff weight in the FMS. The error went unnoticed and did not manifest as an operational problem until the approach into Kalgoorlie."

The flight was 18 minutes behind schedule when it departed from Perth, but the PIC told investigators that preflight preparations, including FMS programming, were normal and not rushed, the report said.

The crew had received information about passenger, baggage and cargo loading via the aircraft communications addressing and reporting system (ACARS) about three minutes before departure. The PIC read aloud the pertinent figures; the copilot entered them into a hand-held computer and then printed the load sheet. After checking the load sheet against the ACARS data, the PIC read aloud what he thought was the zero fuel weight shown on the load sheet, and the copilot entered it into the FMS. (The load sheet lists the zero fuel weight just below the operating weight.)

Before departure, the PIC checked the takeoff weight calculated by the FMS against the maximum weight appropriate for the conditions and was satisfied that it was lower; he did not notice the error.

Later, while nearing Kalgoorlie, the crew entered the runway and weather conditions into the FMS, which calculated the 116-kt V_{REF}, based on the erroneously low landing weight data. At the aircraft's actual landing weight and configuration, the correct V_{REF} was 130 kt, and stall speed was 106 kt.

The crew's use of the incorrect approach speed, 121 kt, rather than the correct approach speed, 135 kt, had reduced the margin to stick shaker activation from 29 kt to 15 kt. "The slower-than-required approach speed led to a higher angle-of-attack and an increase in drag that had an adverse effect on the aircraft's performance and flight control responsiveness," the report said. "As a result, the engine power and pitch attitude required to maintain the desired flight profile were higher than usual, and significant pitch oscillations were evident. Those pitch oscillations contributed to the difficulty experienced by the flight crew in controlling the aircraft's flight path and maintaining a stabilized approach."

The report said that the format of the load sheet increased the risk of a data-entry error. Moreover, the operator's procedures did not require flight crews to validate FMS-calculated landing weights.

"The operator has made a number of enhancements to the format of the 717 load sheet, the FMS weight data-entry and verification procedures, the weight-validation checks and the 717 simulator training in respect [to] recovery from stick shaker activation," the report said.

The operator's procedures did not require flight crews to validate FMS-calculated landing weights.

Another Data-Entry Error

Airbus A321-211. No damage. No injuries.

While departing from Manchester, England, the morning of April 29, 2011, for a flight to Crete with 223 passengers and eight crewmembers aboard, the commander noticed that the sidestick controller "felt heavy" on rotation. After the A321 lifted off the runway, he noticed an indication on his PFD that V_{LS}, the lowest selectable speed providing an appropriate margin to the stall speed, was increasing abnormally.

"He reduced the pitch attitude and covered the thrust levers in case more power was required," said the report by the U.K. Air Accidents Investigation Branch (AAIB). "The aircraft accelerated and climbed, but at a slower-than-normal rate."

En route to Crete, the flight crew checked their takeoff performance calculations and found that they were incorrect. The commander filed an incident report, and investigators found that the commander inadvertently had read aloud the zero fuel weight, 69,638 kg (153,526 lb), from the load sheet, rather than the actual takeoff weight, 86,527 kg (190,759 lb).

Both pilots entered the incorrect takeoff weight and other data in their laptop computers,

The crew did not thoroughly cross-check the takeoff performance calculations.

which calculated V_1 as 131 kt, V_R as 134 kt and V_2 as 135 kt; the correct speeds were 155 kt for both V_1 and V_R, and 156 kt for V_2. The data-entry error also resulted in a calculated power setting that was too low for the planned reduced-thrust, or flex, takeoff.

The report said that the crew did not thoroughly cross-check the takeoff performance calculations by the laptops against those by the FMS, which would have shown discrepancies in the takeoff weight and the "green dot speed," the speed to be used if a takeoff is continued after an engine failure.

"There have been a significant number of reported incidents and several accidents resulting from errors in takeoff performance calculations around the world in recent years," the report said (*ASW*, 2/12, p. 53). "Industry awareness of the frequency of these errors has been raised, but a solution has yet to be found."

Confusion Causes Low Departure

Boeing 737-8F. No damage. No injuries.

The flight crew were preparing for a scheduled cargo flight from London Stansted Airport to Ankara, Turkey, the afternoon of March 13, 2011, when they were assigned the Clacton 8R standard instrument departure (SID) from Runway 22.

While reviewing the published SID procedure, the pilots misunderstood two notes — "Initial climb straight ahead to 850 ft" and "Do not climb above SID levels until instructed by ATC [air traffic control]" — to mean that they were required to maintain 850 ft until they received further clearance to climb.

Altitudes in 100-ft increments, only, could be set in the 737's mode control panel, so the copilot, the pilot flying, set 800 ft. On initial climb, the aircraft exceeded the selected altitude as the copilot engaged the autopilot. "The aircraft pitched nose-down and, after reaching a maximum altitude of approximately 1,050 ft, it descended to 800 ft," or about 450 ft above ground level (AGL), the AAIB report said.

The airport traffic controller saw the aircraft descend in a steep nose-down attitude and radioed the crew. There was no reply because the crew, without authorization, had changed to the London Control radio frequency. The departure controller saw on his radar display that the aircraft was at 800 ft and asked the crew for their current and assigned altitudes.

The pilot replied, "Say again please," and the controller repeated the request. The pilot said, "Now eight thousand eight hundred feet." The controller again asked for the current and assigned altitudes, and the pilot said, "Altitude eight hundred six sixty now."

The 737 was still 450 ft above the ground when the copilot began a left turn to a heading of 88 degrees, as prescribed by the SID. During the turn, the autopilot disengaged and the aircraft's ground-proximity warning system generated a "PULL UP" warning and a "DON'T SINK" warning.

The controller asked the crew to confirm that they were climbing to 4,000 ft, as prescribed by the SID, and the pilot replied, "Now climbing four thousand."

"The aircraft entered a climb, having turned through approximately 100 degrees," the report said. "The remainder of the departure proceeded without further incident."

The report noted that the U.K. Civil Aviation Authority (CAA) has set 500 ft AGL as the minimum height at which a turn can be made during a SID, and that requirement is reflected in different ways by the published procedures. The captain had previously flown the Dover SID out of Stansted, which includes the note, "No turns below 850 ft" (airport elevation is 348 ft). Noting that this wording is common on many other SID charts, the report said that the different wording on the Clacton SID, "Initial climb straight ahead to 850 ft," and similar wording on other SIDs can be misinterpreted by pilots, especially those for whom English is not the native language, to mean that they must level the aircraft at that altitude.

"The [737] pilot considered that this difference in phrasing was one of the factors that reinforced his misinterpretation of the information on the chart," the report said.

As a result of the investigation, the AAIB recommended that the U.K. CAA ensure that "the vertical profile information [on] SIDs is unambiguous and that the wording used is consistent across all U.K. SIDs."

Conflicting Takeoff Clearances

Embraer 145EP. No damage. No injuries.

The controller-in-charge at Gulfport–Biloxi (Mississippi, U.S.) International Airport was working the local, ground control and clearance delivery positions the afternoon of June 19, 2011, when the flight crew of the Embraer radioed that they were ready for takeoff from Runway 18.

Sixteen seconds earlier, the controller had cleared the pilot of a Cessna 172 for takeoff from Runway 14. However, he did not ensure that the Cessna was clear of the departure area of Runway 18 before clearing the Embraer crew for takeoff, said the report by the U.S. National Transportation Safety Board (NTSB).

Another controller who had just entered the control tower to relieve the controller-in-charge at the local control position heard the takeoff clearances and said, "You've got two rolling." The controller-in-charge did not acknowledge.

The Embraer, with 54 people aboard, was climbing through 300 ft when it passed in front of the Cessna. "No traffic [advisory] was issued to either aircraft by the [controller]," the report said. "Closest proximity was estimated to be 0 ft vertically and 300 ft laterally."

The controller told investigators that, based on previous experience, he had expected that the regional jet would depart well ahead of the light airplane. He "did not comprehend that the Cessna could have departed so rapidly after being issued a takeoff clearance," the report said.

'Extremely Violent' Icecap Turbulence

Boeing 777-200B. No damage. Two serious injuries.

The 777 was at Flight Level 330 (approximately 33,000 ft) during a flight from London to Los Angeles the afternoon of May 25, 2010, when it encountered unforecast icecap wave turbulence over southern Greenland. "According to the captain … the seat belt sign had been off for approximately 30 minutes prior to the turbulence encounter, which he described as 'unexpected and extremely violent,'" the NTSB report said.

Investigators calculated that the airplane encountered a downdraft of about 13 ft/sec (4 m/sec) followed rapidly by an updraft of 24 ft/sec (7 m/sec). "The airspeed quickly increased into the overspeed range, and the first officer [the pilot flying] attempted to control the airspeed by retarding the throttles," the report said. "The airspeed decayed rapidly, then increased immediately back into the overspeed range, with a maximum speed of about 0.874 Mach. He stated that the altitude deviations appeared to be plus or minus 80 to 100 ft and the autopilot remained engaged."

'The airspeed decayed rapidly, then increased immediately back into the overspeed range.'

During the turbulence encounter, a flight attendant suffered a fractured leg and a passenger suffered a fractured ankle. None of the other 195 passengers and 11 crewmembers, or the three flight crewmembers was hurt. The flight crew declared a medical emergency and diverted to Montreal, where the airplane was landed without further incident.

'Gastric Event' Disables Copilot

Fokker F28-1000. No damage. No injuries.

The aircraft was en route on a charter flight with 88 passengers from a mining site in West Angeleas, Western Australia, to Perth the night of July 7, 2011, when the copilot told the PIC that he had a "stabbing pain" in his lower abdomen. "The copilot left the cockpit momentarily to use the toilet, but the pain continued," the ATSB report said. "On his return, he took paracetamol [an over-the-counter medication] for pain relief," but the pain increased.

Shortly after advising the PIC that he was unable to continue his flight duties, the copilot became unconscious. "The PIC reported that the copilot did not respond to verbal or physical stimulus for about 10 seconds," the report said.

He regained consciousness as the PIC was declaring an urgency and requesting medical assistance at Perth. A cabin crewmember administered oxygen to the copilot and adjusted his seat and restraints. After the F28 landed, ambulance personnel administered medical treatment and then transported the copilot to a hospital, where he recovered about 2.5 hours later.

An aviation medical examiner determined that the copilot likely had suffered "an acute gastric event aggravated by dehydration and the food [he had] consumed" earlier that day, the report said.

TURBOPROPS

High, Hot and Committed

Beech King Air C90A. Substantial damage. No injuries.

The aircraft was on a business flight the afternoon of April 14, 2011, to Barbil, India. Because of high terrain south of the airport, Runway 18 is used for landings, and a go-around from short final approach is "almost impossible," said the report by the Indian Directorate General of Civil Aviation.

The King Air crossed the approach threshold at about 300 ft AGL and touched down with about 1,400 ft (427 m) of the 3,500-ft (1,067-m) runway remaining. "Since the speed of the aircraft was high, it could not be stopped within the left-over length of runway," the report said.

The nose landing gear separated, and the engines and propellers were substantially damaged when the aircraft overran the runway and struck a drainage ditch. The two pilots and their passenger were not injured.

Gear Overlooked in Hectic Landing

Fairchild Metro III. Substantial damage. No injuries.

The pilot was conducting a cargo flight to Seattle's Boeing Field, where the winds were from 210 degrees at 16 kt, gusting to 35 kt, the evening of March 10, 2010. He rejected two landings on Runway 13R because of the crosswind and wind shear causing airspeed fluctuations up to 30 kt.

During the third approach, the pilot was told by the airport traffic controller to follow a light jet on final approach to Runway 13R. "Upon reporting the traffic in sight, the pilot was given his landing clearance and subsequently told to 'turn base early' due to another airplane on approach," the NTSB report said.

When the light jet passed its assigned turnoff point on the runway, the controller told the Metro pilot to conduct S-turns for spacing. The Metro was on final approach at about 200 ft AGL, when the controller told the pilot "to go around and to maintain altitude," the report said.

The pilot increased power, retracted the flaps to the approach setting and retracted the landing gear. "About 10 seconds later, the pilot was issued a landing clearance by the controller," the report said.

The Metro touched down with the landing gear retracted, veered off the left side of the runway and came to a stop upright. The airplane was substantially damaged, but the pilot escaped injury.

Aileron Separates on Training Flight

Beech King Air 90B. Minor damage. No injuries.

The King Air was on a downwind leg to land at Chickasha (Oklahoma, U.S.) Municipal Airport the morning of April 11, 2011, when one of the pilot-rated passengers seated in the cabin told the flight instructor that the right aileron had partially separated from the wing. The flight instructor assumed control from the student, who was training for a commercial license, and landed the airplane without further incident.

Examination of the aileron revealed that the two inboard hinges had come loose because the attachment bolts were not installed properly in the corresponding nut plates. "The aileron was not damaged, so a mechanic attached the aileron properly to the aileron hinge points, and the airplane was returned to service," said the NTSB report.

The incident occurred 10 days and 5.3 flight hours after a phase inspection of the airplane that included removal of the right aileron to repair light surface corrosion. A maintenance technician did not properly reinstall the aileron after the work was completed, said the report, noting that a similar incident occurred on Feb. 15, 2011, when an aileron separated from an E90 during a postmaintenance functional check flight in Des Moines, Iowa (*ASW*, 2/12, p. 61).

The maintenance manual for the King Air 90 series says that during aileron installation, maintenance technicians should "carefully align the three hinges with the aileron and install the bolts in each hinge bracket and the aileron." It also says, "Pull on the aileron straight away from the wing. If any movement is detected, carefully check the bolt installation."

In 2003, the manufacturer notified operators that it had received reports of improperly installed ailerons. "Some operators have painted witness marks on the aileron hinge brackets to give technicians a visual cue that installation is incorrect," the notice said.

Prop Strikes Out-of-Place GPU

De Havilland Dash 8. Substantial damage. No injuries.

A marshaler and wing-walkers were guiding the airplane to the ramp at Phoenix (Arizona, U.S.) Sky Harbor International Airport the afternoon of April 20, 2009, when the captain lost sight of a ground power unit (GPU) off the right side of the airplane. He asked several times whether they were clear of the GPU, and the first officer replied that they were.

"However, the right engine's propeller blades struck the GPU as the marshaler was crossing his arms [as a signal] to stop movement," the NTSB report said. After being struck by the propeller blades, the GPU contacted the right wing and fuselage, causing structural damage.

Investigators found that the GPU had been parked about 7 ft (2 m) from its designated parking area.

PISTON AIRPLANES

Airspeed Inadequate for Icing

Beech 58 Baron. Substantial damage. Two fatalities.

A cold front extended along the route from Frederick, Maryland, U.S., to Olive Branch, Mississippi, the afternoon of April 27, 2010, and the pilot's preflight weather briefing had included an advisory for moderate icing conditions from 5,000 ft to 16,000 ft.

The Baron, which was equipped and certified for flight in icing conditions, was at 12,000 ft when the pilot requested a lower altitude because the airplane was "losing airspeed." ATC cleared him to descend to 7,000 ft. "The pilot acknowledged the clearance and requested a lower altitude because he was still losing airspeed," the NTSB report said. He subsequently was cleared to descend to 5,000 ft.

"The pilot continued reporting airspeed problems during his descent," the report said. "The last communication from the pilot was: 'Just went down like an absolute rock. Don't know what happened.'"

ATC then lost radio and radar contact with the Baron. The airplane was in a 30-degree nose-down attitude when it subsequently struck a heavily wooded hillside near Bear Branch, Kentucky. "A post-accident examination of the wreckage revealed no preimpact anomalies with the engines, airframe or systems that would have precluded normal operation," the report said. "It is probable that the airplane may have accumulated ice on its surfaces and the pilot was unable to maintain an adequate airspeed during the descent."

Brakes Fail Due to Air in Lines

Britten-Norman Islander. Substantial damage. No injuries.

After touching down on the runway at Montserrat, United Kingdom, the evening of April 17, 2011, the pilot felt no resistance when he depressed the right brake pedal. "While maintaining directional control with the rudder pedals, the pilot tried to 'pump' the brake pedals, but this had no effect on the right brakes," the AAIB report said.

The 540-m (1,772-ft) runway ends in a near-vertical, 200-ft drop. "To avoid departing the end of the runway, the pilot applied left brake and allowed the aircraft to veer left onto the grass," the report said. The nose landing gear, left wing tip and left propeller were damaged when the Islander struck an embankment, but the seven passengers and the pilot escaped injury.

"The loss of right braking was attributed to trapped air in the hydraulic lines, which was probably introduced during a right brake O-ring seal replacement prior to the accident flight," the report said. "Following this repair work, the right brakes had not been bled in accordance with the aircraft maintenance manual."

Distracted by Paperwork

Beech B80 Queen Air. Substantial damage. No injuries.

While holding on a taxiway for departure from Minneapolis–St. Paul (Minnesota, U.S.) International Airport the morning of Feb. 24, 2010, the pilot set the parking brake and attended to some paperwork for the cargo flight. He later told investigators that the parking brake "obviously was not set hard enough," the NTSB report said.

The Queen Air rolled forward and struck another airplane operated by the same cargo company. The collision caused minor damage to the Queen Air's propeller and substantial damage to the other airplane's empennage. Inspection of the Queen Air's parking brake system revealed no anomalies.

HELICOPTERS

Bearing Failure Causes Power Loss

Bell 407. Substantial damage. Two serious injuries.

The 407 was transporting six skiers to a drop site at 6,000 ft near Blue River, British Columbia, Canada, the morning of Dec. 15, 2010. While climbing at 65 kt about 200 ft above rising terrain near the drop site, the pilot heard a bang and felt the helicopter shudder when an engine compressor stall occurred. The low-rotor-speed and engine-out horns then sounded.

"Moments later, the helicopter landed heavily, and the pilot and the ski guide, respectively seated in the right and left front seats, sustained back injuries," said the report by the Transportation Safety Board of Canada. The other five skiers were not injured.

Investigators determined that the compressor stall and the power loss were caused by the failure of the no. 2 bearing, which supports the aft end of the compressor rotor. "The bearing failure was unusual, in that it was very rapid and was not preceded by a chip detection warning," the report said.

Tail Rotor Sheds Balance Weights

Bell 206L-4. Substantial damage. No injuries.

The LongRanger was in cruise flight the afternoon of March 3, 2011, when the pilot felt a high-frequency vibration in the airframe and flight controls. He declared an urgency and landed the helicopter next to a runway at London City Airport. The tail rotor gearbox mountings and the tail boom were damaged, but the pilot and his passenger were not injured.

"Examination revealed that a bolt securing balance weight assemblies to a tail rotor blade had failed due to the formation of a crack in the bolt shank which propagated in fatigue," the AAIB report said. "The helicopter manufacturer confirmed that this was the first reported occurrence of this nature relating to this design of tail rotor system."

Unlatched Cowling Strikes Main Rotor

Eurocopter MBB-BK 117C-2. Substantial damage. No injuries.

The pilot conducted a preflight inspection of the emergency medical services helicopter at the beginning of his shift on Jan. 1, 2011, and later assisted a maintenance technician in verifying fuel control settings. "Both of these [tasks] required that the engine cowling doors be opened," the NTSB report said.

The pilot told investigators that he checked the security of the doors and cowlings, and the overall condition of the aircraft while preparing to depart that night for a positioning flight from Rochester to Albert Lea, both in Minnesota, U.S. After the pilot started the no. 1 engine, however, a flight medic told him that she heard an "unusual rattle."

"The pilot asked her to check the security of the cowling door latches," the report said. "When the flight medic returned, she informed him that the latches appeared to be secure."

Nearing the destination, the pilot heard a loud bang and felt a vibration. "He elected to continue the approach to the destination helipad and subsequently landed without further incident," the report said. "A post-accident examination revealed substantial damage to all four main rotor blades [and that] the lower portion of the left engine cowling had separated."

Preliminary Reports, February 2012

Date	Location	Aircraft Type	Loss Type	Injuries
Feb. 2	Anchorage, Alaska, U.S.	Beech 99	major	7 none
Day visual meteorological conditions (VMC) prevailed when the airplane struck terrain short of the runway while landing at Merrill Field.				
Feb. 2	Pueblo, Colorado, U.S.	Learjet 35	minor	10 minor/none
Night instrument meteorological conditions (IMC) prevailed, and winds were from 160 degrees at 15 kt when the Learjet veered off the right side of Runway 08L before reaching V_1 on takeoff.				
Feb. 2	Elmira, New York, U.S.	Beech 99	minor	1 minor/none
The airplane came to a stop on its belly cargo pod after the landing gear retracted during the landing roll.				
Feb. 3	Pristina, Serbia	Eurocopter SA 330	major	11 none
The pilot landed the Super Puma in a field after it lost power on takeoff.				
Feb. 3	Boise, Idaho, U.S.	Lancair Propjet	total	1 fatal
The pilot had reported a "problem" after rejecting the first takeoff. On the second attempt, the experimental single-turboprop climbed about 200 ft, entered a steep left bank and rolled once while descending to the ground.				
Feb. 4	Bilai, Papua, Indonesia	Pacific Aerospace 750XL	major	2 minor/none
The airplane had a cargo of diesel fuel when it veered off the runway and struck a ditch after the left main landing gear collapsed on landing.				
Feb. 5	Miyagi, Japan	Airbus A320	major	166 minor/none
Day VMC prevailed when the A320's tail struck the runway during a late go-around at Sendai Airport.				
Feb. 10	Madison, Wisconsin, U.S.	Daher-Socata TBM 700	major	3 minor/none
Day VMC prevailed when the airplane pitched up shortly after lift-off and then entered a steep nose-down descent to the ground.				
Feb. 11	Wheatland, Wyoming, U.S.	Bombardier Learjet 31	major	4 none
The main landing gear collapsed while the Learjet was landing during an emergency medical services (EMS) flight.				
Feb. 12	Bukavu, Democratic Republic of the Congo	Gulfstream G-IV	total	3 fatal, 3 serious, 3 minor/none
Day VMC prevailed when the G-IV touched down halfway down the 2,000-m (6,562-ft) runway, overran the runway and traveled down a steep embankment. Two people on the ground also were killed.				
Feb. 13	Brooksville, Florida, U.S.	Learjet 55	minor	3 minor/none
Night VMC prevailed when the Learjet veered off the runway on takeoff, collapsing the nose landing gear.				
Feb. 13	Craiova, Romania	Saab 2000	major	1 minor, 51 none
Day IMC prevailed when the airplane veered off the runway on takeoff and came to a stop in deep snow.				
Feb. 14	Brisbane, Queensland, Australia	Fairchild Metro	major	2 minor/none
The flight crew was unable to extend the landing gear during a night post-maintenance functional check flight and landed the Metro with the gear retracted.				
Feb. 15	Jackson, Wyoming, U.S.	Bell 407	total	1 fatal, 2 serious
Witnesses said that the pilot appeared to experience control difficulties as the EMS helicopter departed from a snowmobile accident site. They lost sight of the 407 before it struck trees and terrain.				
Feb. 17	Thandwe, Myanmar	ATR 72	major	34 none
The flight crew was unable to extend the nose landing gear and landed with it retracted.				
Feb. 18	Tanai, Russia	Let L-410 Turbolet	major	2 minor/none
The right main landing gear collapsed on touchdown after the Turbolet struck a truck on final approach. The truck then struck a minibus, seriously injuring a passenger.				
Feb. 19	Hokkaido, Japan	Eurocopter EC 120	major	1 minor/none
The helicopter turned over while landing on Mount Karifuri.				
Feb. 21	El Refugio, Mexico	Rockwell Turbo Commander	total	3 fatal
The airplane crashed under unknown circumstances during a night law-enforcement flight.				
Feb. 27	Newark, New Jersey, U.S.	Embraer 170	major	73 minor/none
The flight crew was unable to extend the nose landing gear and landed the airplane with it retracted.				
Feb. 28	Manaus, Brazil	Cessna 208 Caravan	total	1 fatal
A witness said that the "propeller stopped" shortly before the Caravan struck a power pole and crashed during takeoff.				
Feb. 28	Rio Dulce, Guatemala	Bell 206	major	3 minor/none
The pilot made a forced landing after the helicopter struck power lines during a flight in day IMC.				

This information is subject to change as the investigations of the accidents and incidents are completed.

Source: Ascend

Selected Smoke, Fire and Fumes Events in the United States, November 2011–January 2012

Date	Flight Phase	Airport	Classification	Subclassification	Aircraft	Operator
11/9/2011	Descent	Dallas/Fort Worth (DFW)	Air distribution system	Smoke	Boeing 737	American Airlines
The crew reported an electrical odor and fumes in the aft cabin. An emergency was declared, and the flight landed at DFW without incident. The aircraft was removed from service. Maintenance replaced the right recirculation fan and filter.						
11/11/2011	Climb	Fargo, North Dakota (FAR)	Cabin cooling system	Smoke	McDonnell Douglas DC-9	Delta Air Lines
On a flight from FAR to Minneapolis-St. Paul, the right air conditioning pack began overheating with smoke in the cabin and did not react to "AUTO" selection. The pilots went to manual control and the flight returned to FAR. Maintenance replaced the right coalescer bag, right cabin temperature sensor and right temperature controller.						
11/11/2011	Climb	Dallas/Fort Worth (DFW)	—	Smoke	Embraer EMB-145LR	American Eagle Airlines
During the climb, the crew reported that, after the ice protection test, smoke came into the cabin and cockpit along with a loud humming sound over the wing root area. The crew declared an emergency and returned to DFW. The aircraft was landed without incident. Maintenance removed and replaced the no. 1 air cycle machine (ACM).						
11/17/2011	Descent	Newark, New Jersey (EWR)	Air distribution fan	Smoke	Boeing 737	US Airways
Upon initiating descent from Flight Level (FL) 350, a fairly strong electrical burning odor permeated the entire cabin. The flight crew initiated quick reference handbook procedures. The fumes subsided and the airplane was landed at the nearest suitable airport, EWR. Maintenance operated the right and left recirculation fans and confirmed that the odor was present only when the right recirculation fan was operating. They removed and replaced the fan.						
11/24/2011	Cruise	San Juan, Puerto Rico (SJU)	Air distribution system	Clogged	Boeing 767	US Airways
En route, about 23 minutes into the flight, a flight attendant in the back of the aircraft reported a burning rubber odor. The flight crew evaluated the situation for about three minutes. The burning rubber odor became stronger. The airplane was returned to SJU and was landed without further incident. Maintenance replaced air circulation filters that were found clogged.						
12/1/2011	Landing	—	Air distribution system	Smoke	Boeing 737	Southwest Airlines
A flight attendant detected a burning plastic or rubber odor in the front main cabin. The pilots declared an emergency and continued the landing. Maintenance removed and replaced a recirculation fan.						
12/2/2011	Takeoff	Las Vegas (LAS)	Auxiliary power unit oil system	Dirt/smoke	McDonnell Douglas DC-9	American Airlines
Cabin crew reported smoke after takeoff. The pilots declared an emergency, and the flight was returned to LAS and landed without incident. The aircraft was removed from service. Technicians found excessive residual oil from the auxiliary power unit.						
12/7/2011	Climb	Nashville, Tennessee (BNA)	Cabin cooling system	Smoke	Boeing 737	US Airways
The crew reported an in-flight electric or plastic burning odor, verging on intense, from the aft cabin vent. The crew declared an emergency and returned to BNA without further incident. Maintenance determined that the right pack ACM was the source of the smell and replaced it.						
12/8/2011	Descent	—	Heating system	Smoke	Learjet 45	Charter
Following initial descent from FL 430 and when passing through FL 400, the flight crew noticed fumes and smoke accumulating in the cockpit and cabin. An emergency descent was initiated, and after passing through FL 200, the smoke and fumes rapidly dissipated. A normal landing was made. Maintenance found the cockpit heat temperature excessively high when running in manual mode. Further troubleshooting found the cockpit heat control valve not responding to inputs in manual or auto mode. The cockpit heat temperature control valve was replaced.						
12/21/2011	Climb	—	Auxiliary power unit core engine	Smoke	Bombardier Challenger CL-600	Air Wisconsin Airlines
On departure, smoke accompanied by an acrid odor entered the cockpit. The smoke subsequently cleared. Maintenance inspected the aircraft and found glycol in the auxiliary power unit area. The unit was cleaned and operated with no recurrence of smoke.						
1/7/2012	Cruise	Tampa, Florida (TPA)	Air distribution system	Smoke	Airbus A320	Virgin America
About 3 ½ hours into the flight, the flight crew detected a strong chemical odor while in cruise. They were unable to determine its origin. The flight crew donned oxygen masks and declared an emergency with en route air traffic control, followed by a diversion to TPA. Once on the ground, the crew advised maintenance of the odor in cockpit and cabin areas. No defects or source could be found.						
1/24/2012	Climb	—	Blower motor	Burned	Gulfstream 690B	FARS Part 135 charter
During climbout, the pilot selected windshield defogging. An electrical odor was detected in the cockpit and smoke emerged from behind the instrument panel. The pilot noticed that the defogger blower was not functional. The aircraft was returned to its departure airport. Investigation revealed a windshield blower motor failure. Maintenance replaced the motor.						

Source: Safety Operating Systems and Inflight Warning Systems

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