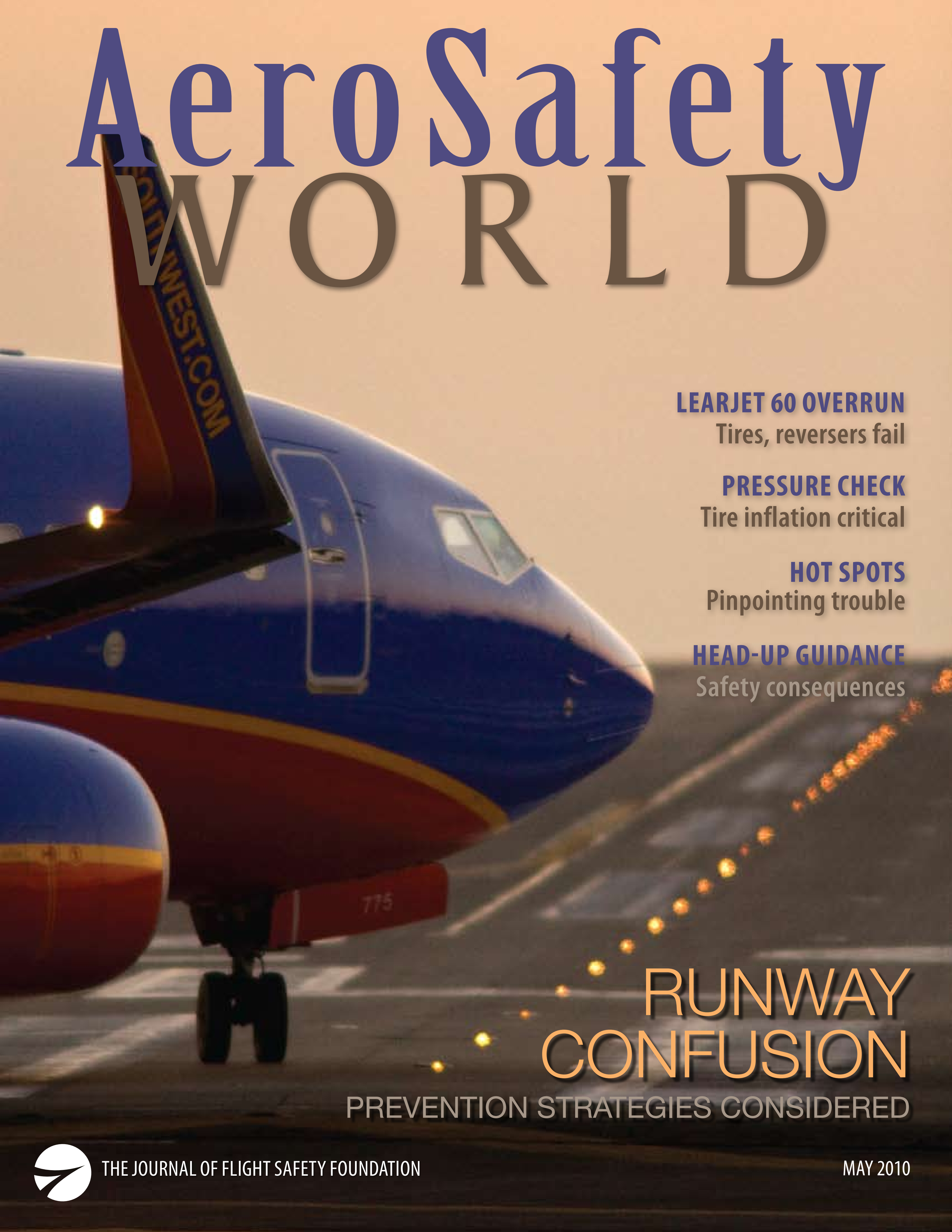
AeroSafety WORLD



LEARJET 60 OVERRUN
Tires, reversers fail

PRESSURE CHECK
Tire inflation critical

HOT SPOTS
Pinpointing trouble

HEAD-UP GUIDANCE
Safety consequences

RUNWAY CONFUSION

PREVENTION STRATEGIES CONSIDERED

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

MAY 2010

ANOTHER BRICK IN The Wall

I had the pleasure of recently attending a conference on fatigue risk management systems (FRMS) in Mexico City. It is gratifying to watch these systems mature and be put into use by operators around the world. There is no question that fatigue is a major risk that must be managed, but I think it is important to understand how these systems fit into the context of other safety systems and programs being implemented globally.

The unfortunate truth is that people, in their enthusiasm, sometimes see new initiatives such as FRMS providing the answer to everything. Whatever else was in place is put aside, and everybody chases after the new thing.

That isn't how the safety business is supposed to work. It is too easy to forget that we are supposed to make the system safe by building layers of protection. Just because somebody suggests we build a new layer doesn't mean we have to tear the others down.

Let's look at FRMS in that context. New standards and guidance materials are set to roll out of the International Civil Aviation Organization (ICAO). Both the U.S. and Europe are working on rule making. Other countries such as Australia and New Zealand have years of experience. Safety managers around the world will soon have everything they need to build another important layer of protection into the system. This is great as long as it is treated as another safety layer or program and not as a substitute for a broader safety management system (SMS).

Consider what FRMS can and can't do: Fatigue risk management systems *can* predict the risk of fatigue affecting the operation; FRMS can help managers find ways to reduce fatigue risk; and FRMS may even identify practical rostering solutions that will improve safety without putting the company out of business. In a world full of overworked and overstressed operators, I believe FRMS will be a real lifesaver.

Let's consider next what FRMS *can't* do. FRMS alone can't help you manage the risk of an airplane crashing. If you dispatch a flight to a destination with difficult terrain, bad weather, at night, with a non-precision approach flown by a crew that does not know the airport, then you have a pretty high risk of a controlled flight into terrain (CFIT) accident. FRMS will not tell you how to fix that situation. It only can tell you if the fatigue level of the crew is likely to make the situation better or worse, information that is only one piece of the safety puzzle.

So now that this latest safety advancement is being laid at our feet, I say we need to use it as it is intended, to shore up our safety defenses where they have been weak. It is time to treat fatigue as a serious threat. It is a killer that deserves the same attention we give to CFIT, approach and landing accidents and the weather. By building FRMS into our SMS we can manage this silent threat in a way that both makes sense and saves lives.

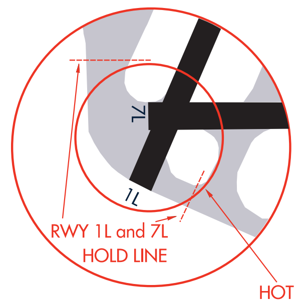
William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

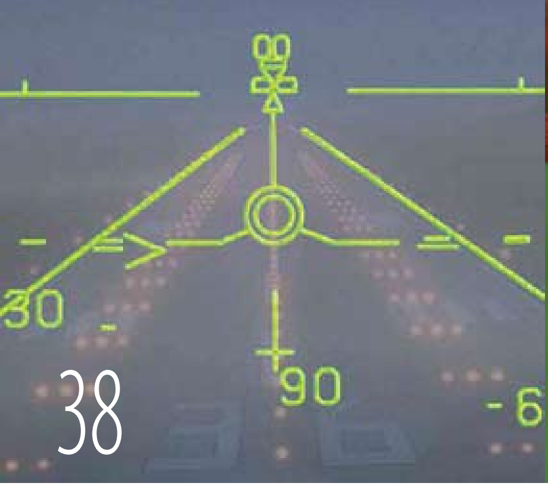
contents

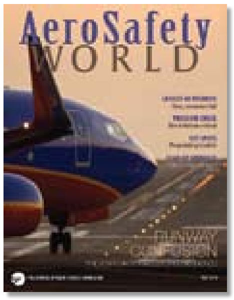
May2010 Vol 5 Issue 4

features



departments





About the Cover
Vigilance can reduce the risk of a runway confusion event..
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PAPERS Please

For a domestic operator, the United States provides one of the largest contiguous airspaces in the world governed by common rules and procedures. However, the comfort domestic flying confers can set up the unwary for a major problem when oceans are crossed and a different regard for International Civil Aviation Organization (ICAO) standards and recommended practices is encountered.

I'm sure the U.S. Federal Aviation Administration (FAA) seriously considers everything that comes out of ICAO. However, it has fewer reasons for quickly adopting all of it. The size of the American aviation industry alone is a major impediment to change. It is difficult to justify major changes in how things are done when the affected community is so insular, large and vocal, and there are no urgent problems to correct.

But some nations, especially in Europe, are getting quite comfortable exercising regulatory authority over aircraft registered in other lands but wishing to land in or even transit their airspace.

This concern about the safety of visiting aircraft was expressed early on by the Safety Assessment of Foreign Aircraft, in which aircraft are inspected on airport ramps during their EU stay. This program, which is still in force, was followed by the EU-wide blacklist program.

Lately, France seems to be taking the lead in a new effort that emphasizes the need for operators to be in compliance with ICAO directives or be denied entry. Most of these rules apply, French authorities believe, to aircraft operated under U.S. Federal Aviation Regulations (FARs) Parts 121 and 135. And while Part 91 aircraft might slide by some rules, if the aircraft is carrying a customer, that person may be viewed ultimately as contributing to the financing of the trip under the strict interpretation being used to apply Part 135 rules.

France requires that the "Operating Permit Questionnaire" be submitted by all operators from outside the EU that have not been in France since Jan. 1, 2008. The questionnaire, to be submitted at least two days before a one-time operation, is extensive, nearly a remote audit of the operator's home country regulatory authorities.

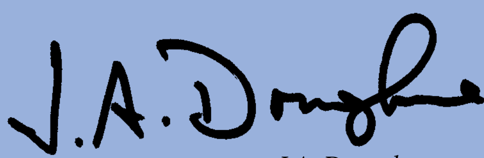
Among the information requested are details on recurrent crew training and testing, including type and location of simulators used and the amount of ground training annually, and how many proficiency checks the cockpit crewmembers complete each year.

But then it goes on to ask if the operator has established a safety management system (SMS), and if a flight data monitoring program is in place, and, if so, what percentage of flight data is being analyzed.

This last bit, says John C. Flemming, Flight Data Services executive VP, has tripped up a number of U.S. operators, including some Part 121 operators, who either didn't have an SMS program with routine flight data analysis, or analyzed less than 50 percent of the data, and their operation was denied, an experience that brings his company new customers.

Flemming says this insistence on adherence to ICAO standards is spreading, with Belgium, Brazil and Russia joining in, even to the point of demanding registration numbers under the left wing and national flag display.

It seems as if the era of reciprocal agreements and casual acceptance of non-ICAO standards is fading. This change will apply to everyone, but it will come as a greater shock to U.S. operators accustomed to their way of doing things.



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

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Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,040 individuals and member organizations in 128 countries.

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

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

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

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

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

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

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

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

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

MAY 24–27 ➤ RAA 35th Annual Convention. Regional Airline Association. Milwaukee. <raa@raa.org>, <www.raa.org/AnnualConvention/tabid/89/Default.aspx>, +1 202.367.1170.

MAY 24–28 ➤ Air Traffic Control Investigation Course. Southern California Safety Institute. San Pedro, California, U.S. Sharon Morphew, <registrar@scsi-inc.com>, <www.scsi-inc.com/ATCI.php>, +1 310.517.8844.

MAY 25–26 ➤ 22nd Maintenance Human Factors Symposium. Royal Aeronautical Society. London. <conference@aerosociety.com>, < www.raes.org.uk/conference/PDFs/639.pdf>, +44 (0)20 7670 4345.

MAY 25–26 ➤ Regulatory Affairs Training. JDA Aviation Technology Solutions. Fort Worth, Texas, U.S. Josh Plave, <jplave@jdasolutions.aero>, <www.jdasolutions.aero/services/regulatory-training.php>, +1 301.941.1460, ext. 170.

MAY 25–27 ➤ Managing Human Factors in Complex Systems. Emergency Solutions Limited and Wiegmann, Shappell & Associates. Trinidad. <register@esltt.com>, <www.esltt.com>, +868 652.5186; +868 385.4609.

JUNE 1–3 ➤ Shared Vision of Aviation Safety Conference. U.S. Federal Aviation Administration. San Diego. <conferenceinfo@utrs.com>, <www.aviationsafetyconference.com>, +1 856.667.6770, ext. 163.

JUNE 4–6 ➤ Australian and New Zealand Societies of Air Safety Investigators Conference. Canberra, Australia. <www.asasi.org/anzsasi.htm>.

JUNE 8–10 ➤ Aviation Ground Safety Seminar. National Safety Council, International Air Transport Section. Chicago. Sloan Grubb, <sloane.grubb@nsc.org>, 800.621.7615, ext. 52227.

JUNE 9–11 ➤ Wildlife Management Workshop. Embry-Riddle Aeronautical University. Seattle. Allen Newman, <Prescott.Birdstrike.Project@erau.edu>, <worldwide.erau.edu/professional/seminars-workshops/external-link-seminars-and-workshops-online-registration.html>, 866.574.9125 or +1 386.226.7694.

JUNE 10–11 ➤ SMS Workshop. ATC Vantage. Tampa, Florida, U.S. <registrations@atcvantage.com>, <atcvantage.com/sms-workshop.html>, +1 727.410.4759.

JUNE 13–17 ➤ Safety Management Training Academy. Association of Air Medical Services. Wheeling, West Virginia, U.S. Natasha Ross, <nross@aams.org>, <www.aams.org>, +1 703.836.8732, ext. 107.

JUNE 14–18 ➤ Human Error in Accident Prevention. Southern California Safety Institute. San Pedro, California, U.S. Sharon Morphew, <registrar@scsi-inc.com>, <www.scsi-inc.com/HEAP.php>, +1 310.517.8844.

JUNE 14–18 ➤ Aviation SMS Course and Workshop Taught in Spanish. Prism Training Solutions. Denver. John Darbo, <John.Darbo@argus.aero>, <www.aviationresearch.com>, +1 513.852.1057.

JUNE 15–17 ➤ Cabin Safety Workshop. U.S. Federal Aviation Administration Civil Aerospace Medical Institute. Oklahoma City, Oklahoma, U.S. Lawrence Paskoff, <lawrence.paskoff@faa.gov>, <www.faa.gov/data_research/research/med_humanfacs/aeromedical/cabinsafety/workshops>, +1 405.954.5523.

JUNE 21–22 ➤ ICAO Global Civil Aviation Search and Rescue Forum. United Arab Emirates General Civil Aviation Authority. Abu Dhabi, United Arab Emirates. Brian Day, <bday@gcaa.ae>, +971 50 9353617.

JUNE 21–23 ➤ Seminar: "Learning From Investigations." United States Society of Air Safety Investigators. Oklahoma City. Troy Jackson, <troy.airsafety@gmail.com>, +1 405.819.7641.

JUNE 21–25 ➤ Fatigue Risk Management. Prism Training Solutions. Denver. John Darbo, <John.Darbo@argus.aero>, <www.aviationresearch.com>, +1 513.852.1057.

JUNE 22 ➤ New Projects Developing Avionic Systems and Flight Deck Operations, and Their Contribution to Future Air Traffic Management. ALICIA. Brussels. <alicia@dblue.it>, <www.alicia-project.eu/CMS/events.html>, +39 06 8555208.

JUNE 23–24 ➤ Aviation Safety Management Systems Overview. PAI Consulting. Alexandria, Virginia, U.S. <SMS@PAIconsulting.com>, <www.paiconsulting.com>, +1 703.931.3131.

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

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

Misinterpreting the Stick Shaker?

I read the article "Startled and Confused" (*ASW*, 3/10, p. 20) regarding the crash of a Colgan Air Bombardier Q400 on approach to Buffalo Niagara (New York, U.S.) International Airport and came to a conclusion that may explain the flight crew's inappropriate response to the stick shaker. I believe that the crew was so involved with the discussion of the effects of the icing conditions that they failed to recognize their deteriorating airspeed. Consequently, when the stick shaker activated while the flaps were traveling between the 10- and 15-degree selection, the crew misinterpreted the stick shaker as a tailplane stall.

Application of power and a rigorous pull force on the control column would be an appropriate response to a tailplane stall. Retracting the flaps to the previous setting is also an appropriate response to a tailplane stall. The SIC may have retracted the flaps in response to a non-verbal cue from the PIC, or she may have perceived this action as a last-ditch chance to control the aircraft in response to previous training. We will never know, but I would recommend that the NTSB review Colgan Air's training syllabus regarding the recognition and response to a tailplane stall.

Kenneth S. Gray
Director of Operations, Executive Fliteways

Pilots' Last Words

I applaud the work done by Flight Safety Foundation, and usually learn something new with each issue of *AeroSafety World*. I also share the Foundation's often-expressed concern regarding the trend toward criminalizing aviation accidents and incidents, and worry that this may start appearing in the U.S. or Canada.

But I have a complaint regarding behavior I'd hoped the Foundation would not exhibit: publishing the dying words of crewmembers, where they have no direct relevance. Such happened with the accident report excerpts chosen for inclusion in the *ASW* report on the Colgan Flight 3407 accident.

There was no need to include the last words of the captain, nor that the first officer could be heard screaming, as the last sounds on the CVR. I accept it is relevant to report that the crew was aware they could not save the situation. And I acknowledge that this information *might* be germane to the accident report. But I do not accept that *ASW*, or any other journal, has a moral or ethical responsibility to publish what, to the families and close friends of these pilots, would be incredibly painful reminders of their loss.

Such information does nothing to enhance your reporting of the facts, or lessons learned from such events. To me it is purely sensationalism and I abhor it.

I urge you to discuss this amongst your editorial steering group, and decide to take out the sensation and insult to the bereaved. Thank you for considering my concern.

Alan H. Gurevich
System Safety Engineer,
Accident Investigator, MD-11 pilot

Head Count

Concerning the item about a near-collision between a Boeing 767 and a McDonnell Douglas MD-82 at Chicago (*ASW*, 4/10, p. 57): If the crew numbers for the 767 are correct — five — that flight was surely illegal. The five would include the two pilots, making three cabin staff — on a trans-Atlantic 767 flight?

Norman Hogwood
Co-Director, Airside SimuDrive
Auckland, New Zealand

The editor replies: *The reader is correct. There were 12 crewmembers aboard the 767.*

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

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

Safety News

Out of the Ashes

The aviation community must be "faster and more flexible" in its responses to limit the disruption of air traffic caused by volcanic eruptions and other natural disasters, says Siim Kallas, the European Commission vice president responsible for transport.

"Most importantly, we need a package of measures to ensure that millions of people and businesses never have to re-live the crisis of the last few weeks," Kallas said, referring to the widespread grounding of air traffic in Europe in April and May because of clouds of volcanic ash from Iceland's Eyjafjallajokul volcano.

European Union (EU) transport ministers have identified five priorities, including accelerating implementation of the Single European Sky to provide for one regulatory authority with jurisdiction over aviation throughout the continent.

Other priorities call for drafting EU proposals to present to the International Civil Aviation Organization for managing risks from volcanic activity, creating guidance for the uniform application of rules for passengers, providing guidelines to avoid "undue distortions to competition" if EU members provide state aid to ease financial pressures on airlines, and developing pan-European transportation networks that can help remove transportation bottlenecks.

© Johann Helgason/iStockphoto

"No one can prevent a volcano eruption or other kinds of natural disaster," Kallas said. "But we can build strong pan-European transport systems so that different modes can ease the pressure when a crisis occurs."

Meetings are planned for June on "possible options for a framework for pan-European mobility planning," Kallas added. "We will never compromise on safety, but we have to do everything possible to safeguard our citizens' freedom to travel."

Australia's PBN Plans

Australia's Civil Aviation Safety Authority (CASA) is working toward implementation of a performance-based navigation (PBN) plan designed to harmonize with international PBN concepts.

CASA's plan aims to provide the strategy for transitioning from route-based navigation to area navigation, and to avoid imposing unnecessary requirements for multiple pieces of equipment on aircraft, multiple systems on the ground, and multiple airworthiness and operational approvals for inter-regional and international operations.

"Australia's concept for the transition to PBN [calls for] parallel availability of area navigation and required navigation performance specifications in all classes of airspace [and] APV [approach with vertical guidance] enabled through barometric vertical navigation," CASA said.

Cockpit Distractions

U.S. air carriers have been told to crack down on distractions in the cockpit — including eliminating pilots' use of personal electronic devices.

The U.S. Federal Aviation Administration (FAA) issued guidance to air carrier operators, directing them to "emphasize to crewmembers and operators that engaging in tasks not directly related to required flight duties, including using personal electronic devices (PEDs), constitutes a safety risk."

A statement accompanying the guidance information cited an October 2009 event in which two pilots of a Northwest Airlines Airbus A320 over-flew their destination airport in Minneapolis by 150 nm (278 km) "because they were using their laptop computers for personal activities and lost situational awareness." The crew failed to respond to numerous radio calls from air traffic controllers. After a question from a flight attendant, the crew realized that they had flown past Minneapolis and returned for a normal landing.

© Ziga Koritnik/iStockphoto

The guidance information told operators to "create a safety culture that clearly establishes guidance, expectations and requirements to control cockpit distractions, including use of PEDs, during flight operations. … Crewmembers should evaluate their personal practices, including those regarding the use of PEDs, to ensure they do not distract from or interfere with duties and responsibilities related to the flight."

Overreliance on SMS?

Despite the significant safety advances made possible by data management systems, the aviation industry should avoid "overreliance on these systems to the neglect of forensic investigation," U.S. National Transportation Safety Board (NTSB) Chairman Deborah A.P. Hersman says.

Hersman told an April meeting of the International Society of Air Safety Investigators (ISASI) in Chantilly, Virginia, U.S., that the use of safety management systems (SMS) and other data systems is one reason for the low rate of aviation accidents.

SMS functions well for companies that already are "getting it right," Hersman said, but it may do little for companies without strong safety cultures.

In addition, some problems are impossible for SMS to identify in advance of a crash, she said, citing a Jan. 17, 2008, accident in which a British Airways Boeing 777 touched down hard short of the runway. The U.K. Air Accidents Investigation Branch traced the problem to ice that formed "within the fuel system from water that occurred naturally in the fuel while the aircraft operated with low fuel flows over a long

Marc-Antony Payne/Wikimedia

period." That risk was not recognized before the accident (*ASW*, 2/10, p. 20).

Hersman said that aviation safety personnel need "a measured approach — one that acknowledges the potential benefits and limitations of SMS and … doesn't discount tried and true methods for identifying vulnerabilities, such as accident investigations."

RESA Recommendations

The Indonesian National Transportation Safety Committee (NTSC) is recommending a review of all airports in Indonesia to ensure that the dimensions of runway end safety areas (RESAs) comply with International Civil Aviation Organization (ICAO) standards.

The recommendation accompanied the NTSC's preliminary report on an April 13 accident in which a Merpati Nusantara Airlines Boeing 737-322 overran the departure end of Runway 35 and stopped 205 m (673 ft) beyond the runway, in the shallow, muddy waters of the Rendani River. Ten of the 110 people in the airplane received serious injuries.

The accident investigation is continuing, but the NTSC issued seven safety recommendations, including one that called on the Directorate General of Civil Aviation (DGCA) to ensure that RESAs meet ICAO standards at all airports that serve Civil Aviation Safety Regulation Part 121 and Part 135 aircraft.

The NTSC also recommended that the DGCA ensure that all Indonesian airports with visual approach slope guidance systems "maintain the equipment to a serviceable standard," especially during Part 121 and Part 135 operations, and that the DGCA review procedures and equipment used by aircraft rescue and fire fighting services to ensure that they meet requirements.

Wikimedia

Digital NOTAMs

The U.S. Federal Aviation Administration (FAA) has begun introducing digital notices to airmen (NOTAMs) to provide computer-generated information about airport safety conditions to pilots and air traffic controllers.

The first airport to participate is Atlantic City International Airport in New Jersey. Plans call for digital NOTAMs also to be provided at 11 other U.S. airports.

The FAA said that digital NOTAMs can be transmitted simultaneously to all air traffic management systems and that the information can be delivered more quickly and with greater accuracy than traditional NOTAMs.

"Digital information management is key to meeting the air traffic system's safety and efficiency goals," FAA Administrator Randy Babbitt said. "It provides one-stop shopping for airspace system changes. It's a great benefit to commercial airline dispatchers who need to quickly assess what's affecting their operations."

EGPWS Warning

Failure of a helicopter's radio altimeter system can interfere with the operation of Honeywell's MK XXII Enhanced Ground Proximity Warning System (EGPWS) by stopping the device's "look-ahead" feature from functioning without warning the pilot, the U.S. National Transportation Safety Board (NTSB) says.

The NTSB recommended that the U.S. Federal Aviation Administration (FAA) require Honeywell to revise the MK XXII EGPWS software logic "so that a fault in the radio altimeter system would not prevent the look-ahead feature from functioning without notification to the pilot." The FAA also should require users of the MK XXII to install the revised software, the NTSB said.

"The look-ahead feature provides visual and aural terrain avoidance alerts by comparing the aircraft's projected flight path to a database containing terrain and obstacle information," the NTSB said. "The absence of these alerts, when the pilot does not know the alerts are not functioning, could mislead the pilot, thereby significantly reducing the safety of flight."

Radio altimeters determine an aircraft's height above terrain and are designed to be accurate when the helicopter is within a specific altitude range. Outside those limits, the output signal is invalid, and a sign/status matrix identifier labels the signal as "no computed data (NCD)"; other system anomalies also may result in an NCD label. The MK XXII is specifically designed for use in helicopters equipped with a radio altimeter.

Nevertheless, the NTSB said, "If a radio altimeter system fault results in the radio altimeter transmitting a signal labeled NCD at the time the helicopter transitions from ground to air, the look-ahead feature of the EGPWS will not be enabled and the pilot will not receive any warnings that this important safety feature is not functional."

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Investigators examine the wreckage of an Air India Express Boeing 737-800 that crashed during an attempted landing at the Mangalore-Bajpe Airport in southern India on May 23 after a flight from Dubai. The airline said that eight of the 166 people in the airplane survived the crash, in which the airplane overran a hilltop runway and burned.

In Other News …

The Global Helicopter Flight Data Monitoring Steering Group has been established, with the announced goal of making helicopter **flight data monitoring** "as accessible as possible" for all helicopter operators. … Up to half of all flight delays in Europe are **"reactionary" delays** — associated with an earlier flight that was late — according to a study published by Eurocontrol. The study found that delays at hub airports affect not only that airport's operations but also flights at dozens of other airports. … The **European Aviation Safety Agency** has established a new working group to identify areas in which the rulemaking process can be streamlined. The group is considering adoption of a "tailor-made" rule-making process for specific areas over which the agency has jurisdiction.

Compiled and edited by Linda Werfelman.


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Another Aircraft Saved!
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- Rick Atkinson III, Director, Yeager Airport
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BY MICHEL TRÉMAUD

Erasing Confusion

Best practices plus updated avionics equal fewer takeoffs and landings on a wrong runway or taxiway.

Taxiway or runway confusion events often are the precursors of runway incursions and, potentially, of ground collisions between two aircraft or between an aircraft and an airport vehicle or construction equipment. Very few of the risk factors are unique. Most can be mitigated by the same safety programs that, in concert with system-level defenses and controls and best practices for flight crews, prevent runway incursions.

Defenses and controls ideally include upgrading and standardizing air carrier fleets to take full advantage of the technologies available. These include proven capabilities cited in the International Civil Aviation Organization (ICAO)–endorsed strategic action plan titled *Implementing the Global Aviation Safety Roadmap,* published in December 2006 as Part 2 of the *Roadmap* developed by the Industry Safety Strategy Group. These recommendations appear in Appendixes E, F and G, available from the ICAO Flight Safety Information Exchange Web site at <www.icao.int/fsix/gasp.cfm> and from Flight Safety Foundation at <flightsafety.org/files/roadmap2.pdf>.

Runway or taxiway confusion events on takeoff end either in a rejected takeoff or continued takeoff, while on approach the conclusion can be either a go-around or a landing. The misused pavement can be a parallel runway, a parallel taxiway, any other active or inactive runway, or any other taxiway or closed runway.

During the takeoff phase of flight, some confusion events have resulted in a taxiway or runway incursion, sometimes with loss of separation

from other aircraft. Others have caused a takeoff from a shorter-than-required runway or taxiway, reducing the safety margins designed into the accelerate-stop distance, the takeoff distance calculation and the anticipated obstacle clearance.

During approach and landing, pilot confusion has caused losses of separation or near-midair collisions as another aircraft approached the same runway or a different runway. Other outcomes have been reduced landing distance available while completing the landing on a shorter-than-required runway or taxiway, resulting in an overrun, or collisions with other aircraft or vehicles.

Recent Analysis

When 14 years of global air carrier safety data were assessed for insights into runway/taxiway confusion events, runway incursions in this period happened twice as often (Table 1). In one recent five-year period, however, three times more fatalities occurred in fatal confusion accidents although they were one-third the number of fatal incursion accidents (Table 2). Two caveats: Such small numbers are inconclusive, and although runway incursions worldwide typically are identified and reported accurately, taxiway or runway confusion events are a newly recognized type of event that may not be captured by today's mandatory and voluntary reporting schemes. This is another reason that confusion events can appear to be statistically insignificant. Yet, as a precursor of harmful or deadly events, their importance should not be underestimated. My recent analysis of 100 confusion events and their regional distribution (Table 3, p. 16) provides more evidence of the continuing and worldwide nature of this threat.

Proportions of 1,429 Accidents, Air Carriers Worldwide, 1995–2008

Type of Event	Number of Events	Percentage of Total
Runway incursion	10	0.7
Runway confusion	4	0.3

Source: Flight Safety Foundation Runway Safety Initiative, 2009

Table 1

Fatal Runway Safety Events, Air Carriers Worldwide, 2002–2006

Type of Event	Number of Events	Number of Fatalities	Percentage of Events	Percentage of Fatalities
Runway incursion	3	17	0.6	0.4
Runway confusion	1	49	0.2	1.2

Source: Flight Safety Foundation Runway Safety Initiative, 2007

Table 2

A number of these events revealed that the lack of a company airport familiarization program was a latent condition. Specifically absent were factors to increase awareness of the complex airport-movement-area layout, especially problematic intersections, ideally depicted on charts as *hot spots* (see "Hot Spot Intelligence," p. 20), and at least some of the standard international markings, signage, lighting and/or procedures.

Flight Dispatch

Lack of flight information or inaccurate flight information contributed to takeoff from or landing on a wrong runway, an unintended runway or a closed runway. Accidents often were avoided through the timely initiation of a rejected takeoff or a go-around. Specifically noted deficiencies were notices to airmen (NOTAMs) that had been prepared but not issued; NOTAMs that were issued but not available to flight crews from the official source; NOTAMs that mistakenly referred to a taxiway or runway that actually was not affected by the notice issued; or NOTAMs that were omitted from the flight dispatch briefing folder.

Also identified were instances in which the runway was used only occasionally for takeoffs; new taxiways or runways were under construction and not shown on the airport diagram; or current airport diagrams failed to show the actual airport configuration, signage, markings and lighting.

Flight Crew Performance

In some events studied, flight crews showed unfamiliarity with the airport due to lack of a company familiarization program and/or inadequate preflight preparation, and some crews had not reviewed relevant NOTAM(s) in the flight dispatch briefing folder. Other factors leading to a crew

100 Confusion Events by World Region, Air Carriers

Region	Percentage of Events
Africa	4
Asia Pacific	13
Europe	28
Latin America	7
Middle East	7
North America	41

Source: Michel Trémaud

Table 3

performance failure include a rushed cockpit atmosphere due to interruptions, distractions and/or high workload, such as receiving final weight-and-balance data or other information from the aircraft communications addressing and reporting system (ACARS) or entering last-minute data into the flight management system (FMS).

In other cases, an automatic terminal information service (ATIS) message was received but relevant information was overlooked, or a new message or special message was not read. The relevant ATIS information sometimes had been noted by the pilot monitoring — also called the pilot not flying — but either was not relayed correctly to the pilot flying or was not comprehended by the pilot flying.

An adequate taxi briefing was absent in some events, representing a failure to use all available flight deck resources such as NOTAMs, the airport diagram and charts, or other airport-specific information. In other cases, no challenge-inquiry occurred between the pilot flying and pilot monitoring, leaving unresolved doubts about aircraft position, runway in use or other facts.

Some flight crews did not seek confirmation of instructions from air traffic control (ATC) when in doubt, or an ATC instruction was accepted by the pilot monitoring but was not followed by the pilot flying. Ineffective crew communication — including failure to verbalize actions, information and clearances — sometimes involved unclear, nonstandard or incomplete phraseology that reduced the situational awareness of ATC.

Other flight crews did not adhere strictly to task sharing or to the "golden rules" of flight operations such as maintaining "one head up" — that is, one pilot's attention focused outside the aircraft — at all times. Some aircraft were taxied without an ATC-cleared taxi route.

Lack of a readback or an incorrect readback, not challenged by the air traffic controller, resulted in confusion events and runway incursions. Some flight crews showed a bias of expectation at a familiar airport, when following the initial ATIS message, or when following a misheard ATC instruction for the assigned runway after their incorrect readback was not detected and corrected.

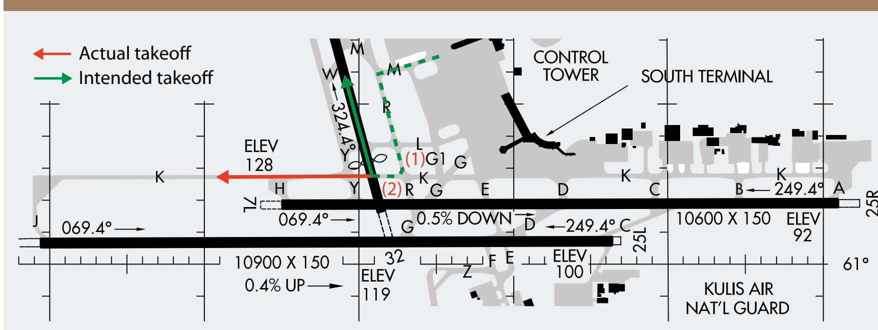
Changeover of function from pilot monitoring to pilot flying — especially captain to first officer just before or during lineup for takeoff — sometimes contributed to confusion because this timing required abrupt transition from head-down tasks to head-up handling duties, as well as quickly updating positional and situational awareness.

The data analysis also showed that a task-sharing scheme in which the captain functioned as pilot flying during ground operations — then made this changeover — decreased the first officer's situational awareness at a critical phase of flight. For example, one confusion event involved early takeoff clearance at location (1) and role changeover at location (2), contributing to a takeoff from Taxiway Kilo instead of the assigned Runway 32 (Figure 1).

One factor in several events was loss of positional awareness, basically an erroneous shift of a pilot's "mental map," resulting in landing at the wrong airport. Another was unawareness of a discrepancy — during descent to the wrong airport — between the actual rate of descent required and the anticipated rate of descent to the correct airport.

Sometimes the rushed approach and high crew workload led to late aircraft configuration for landing. The flight crews lacked adequate positional and energy-state awareness, although awareness-enhancing information

Runway Confusion Event, Ted Stevens Anchorage (Alaska, U.S.) International Airport



(1) = Early takeoff clearance; (2) = Pilot-flying changeover

Source: Michel Trémaud and U.S. Federal Aviation Administration airport diagram

Figure 1

would have been available by monitoring altitude in relation to track distance to runway threshold, observing approach sequence/timing and comparing the raw data and/or navigation display to the chart profile view of the instrument approach procedure.

Some pilots mistakenly lined up with the first visually acquired runway while turning or after turning final, while following radar vectors or a distance measuring equipment (DME) arc, or after breaking out from the overcast.

Other issues included complacency when conducting a visual approach in good weather conditions or at a familiar airport; difficulties transitioning from an instrument landing system (ILS) approach to a visual approach, causing a wrong-runway landing parallel to the assigned runway; and failure to notice the yellow "X" marking at the threshold, signifying a closed runway. Confusion also resulted when this marking was installed only at one runway end, contrary to ICAO standards.

Hypovigilance, a low alertness level caused by fatigue, and employer/personal time pressures possibly contributed to some of the confusion events.

Air Traffic Control

Several ATC-induced risk factors were noted, including these examples: A runway closure was announced in a NOTAM but not in the ATIS message; a controller issued a nonstandard taxi route to the assigned runway; a controller's airport diagram did not show the actual airport configuration, markings, signage and lighting; a controller's airport diagram was not consistent with the flight crew's airport diagram; there were no airport procedures for intersection takeoffs; lack of monitoring of aircraft taxi or approach progress by the controller prevented the timely detection of pilot confusion; or a controller's hearback or challenge was ineffective.

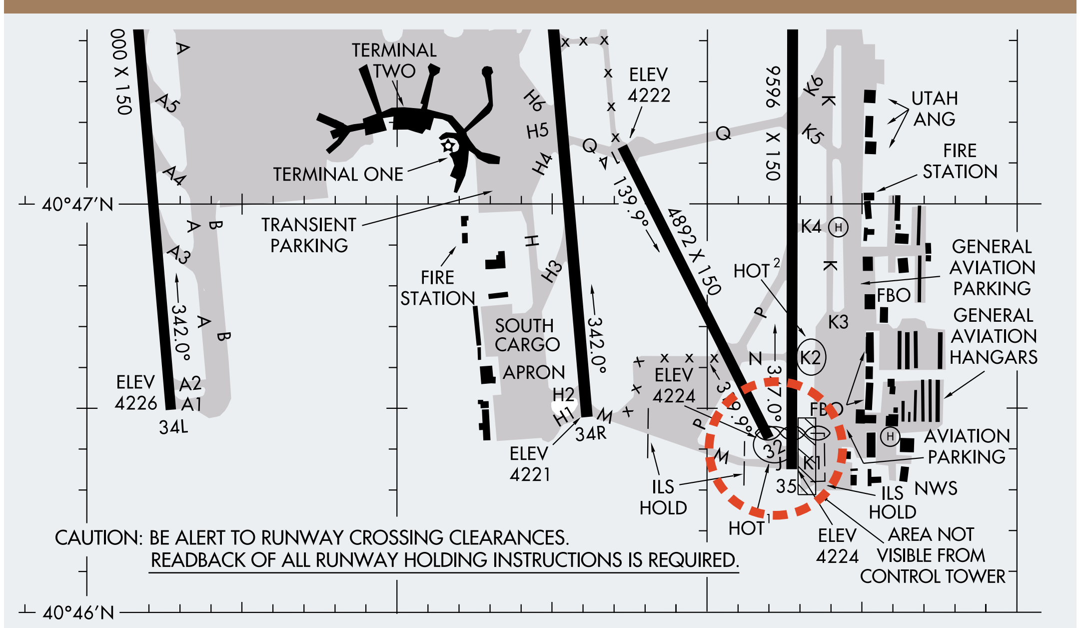
In some events, ATC issued the takeoff clearance without confirming the aircraft's position, at times issuing a takeoff clearance early while the aircraft was still taxiing and had not yet reached the runway threshold or holding position marking of the intended takeoff runway, or before the aircraft had crossed all intersecting runways.

Conflicting information from approach and tower controllers about the assigned landing runway also created confusion for pilots, with controller fatigue a possible contributor.

Infrastructure Design

Airport layout or infrastructure has affected situational awareness, distracting or confusing flight crews. A common example involves airports where a single taxiway serves multiple

Single Taxiway Serving Several Runway Thresholds, Salt Lake City (Utah, U.S.) International Airport



Source: Michel Trémaud, based on information from the U.S. Commercial Aviation Safety Team and Federal Aviation Administration

Figure 2

runway thresholds (Figure 2). Less than optimal geometries here also increase the risk of the flight crew unintentionally taxiing onto the wrong runway, possibly one too short for takeoff. Also revealed was crew unawareness of hot spots, such as locations without taxiway/runway holding position markings to protect runway intersections. Some taxi routes crossed unassigned runways or runway thresholds before the incident aircraft reached the takeoff runway threshold or holding position.

The taxiway lighting sometimes was confusing when it was brighter than adjacent runway lighting.

Color contrasts — a dark-colored taxiway against a light-colored runway — also proved confusing. For example, partial snow removal caused misleading color contrast between the snow-covered active runway and a parallel taxiway that was darker and free of snow. Events also have involved ATC keeping the localizer operative on an inactive runway after switching from parallel-runway operations to single-runway operations.

Other airport-related risk factors were misleading taxiway or runway signage or markings; deteriorated markings, such as missing reflective material or rubbed-off stripes; and markings obscured by patches of snow or ice. The taxiway lighting sometimes was confusing when it was brighter than adjacent runway lighting.

Events also revealed nonstandard lighting practices, such as keeping runway centerline lighting illuminated to assist in runway inspections or searches for foreign object debris. Airports also kept approach lights to one runway illuminated to compensate for the low-intensity lighting on an active parallel runway. Some kept the visual approach slope indicator or precision approach path indicator operative alongside an inactive runway, or activated the overall runway lighting system of a closed runway while inadvertently deactivating the same system for the active runway.

Risk Management

On the positive side, runway safety teams — involving all stakeholders at airports in many countries — have encouraged aircraft operators to assess continuously the main threats, such as changes to the preferential runway system; find safe solutions to airport layout complexity and construction activity; and fix nonstandard markings, signage, lighting and ATC procedures.

Two recommended resources from the newly updated Flight Safety Foundation *Approach and Landing Accident Reduction (ALAR) Tool Kit* — the "Risk Awareness Tool" and the "Risk Reduction Guide" — support these types of ongoing safety assessments, encouraging airport familiarization programs and emphasizing actual event–based recurrent training.

The *ALAR Tool Kit* concurs that operators should assess the robustness of their dispatch information–gathering and briefing process, including the collection and dissemination of all relevant NOTAMs; compilation of flight dispatch briefing folders; completeness of the dispatcher–flight crew briefing; and updating of the FMS navigation database cycle and FMS initialization, as appropriate, with data from NOTAMs, such as inoperative navaids.

Company flight operations policies, standards and standard operating procedures (SOPs) also should include a "sterile cockpit" policy in compliance with regulations around the world, including U.S. Federal Aviation Regulations Part 121.542 or EU OPS 1.192 (h) and 1.210 (c). Guidance on embedding coping strategies in SOPs, mitigating interruptions and minimizing distractions is available in ALAR Briefing Note 2.4, "Interruptions/Distractions." Pilot-controller communication, using standard phraseology and adhering to best practices, has been summarized in ALAR Briefing Note 2.3, "Pilot-Controller Communication." Elements of ALAR Briefing Note 1.6, "Approach Briefing," also are applicable to reducing risk of runway or taxiway confusion.

Many other best practices in the *ALAR Tool Kit* address confusion. When taxi instructions are received from ATC, for example, both pilots should refer again to the airport diagram and verbalize agreement about the assigned runway and taxi route, including any instructions to hold short of or cross an intersecting runway. The taxi and hold-short instructions should be copied as a memory aid and for reference. This practice also helps crews to be prepared to follow the clearance or instructions they actually received, not what they expected to receive.

Awareness of hot spots enables pilots to plan checks and actions to minimize workload and distractions upon arrival at these locations. If applicable, low-visibility taxi procedures and routes, and the characteristics of the airport surface movement guidance and control system, should be discussed. If any doubt exists about the taxi route and/or low-visibility taxi procedures, progressive taxi instructions should be requested.

Operator SOPs also should contain best practices to enhance situational awareness. Some European recommendations call for each pilot to have the necessary airport layout charts readily available. They also say an illuminated stop bar should never be crossed. ATC will provide explicit instructions about any alternate procedure necessitated by malfunction or other contingency. Any action that distracts the operating flight crew from taxi tasks — such as making a public address system announcement — should be avoided or made only with the parking brake set.

More best practices may be selected, as applicable, from U.S. Federal Aviation Administration (FAA) Safety Alert for Operators (SAFO) 06013, "Flight crew techniques and procedures that enhance pretakeoff and takeoff safety." As critical steps for the lineup check, for example, this SAFO recommends confirming the intended takeoff from the runway threshold or from an intersection, as per performance calculations, and making sure of the airplane's location at the assigned departure runway before crossing any holding position marking.

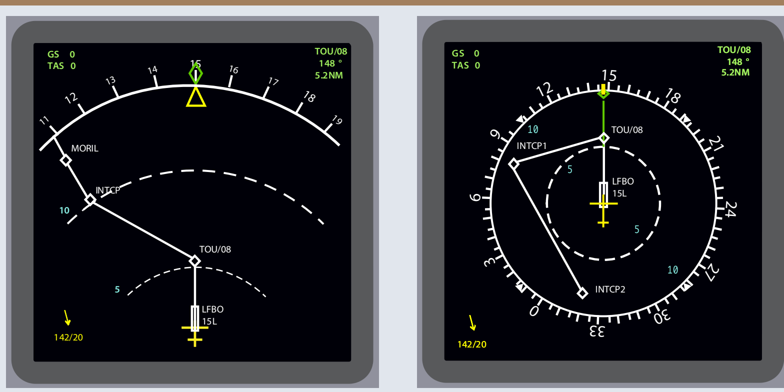
Current guidance calls for checking — during and after lineup — the aircraft heading against the assigned runway heading and the runway designation markings, if conducting the takeoff from the runway threshold, as well as the correctness of the aircraft and runway symbols on the navigation display. The aircraft symbol should be initialized at the threshold of the runway selected in the FMS flight plan. The "TO WPT" and the depiction of the standard instrument departure (Figure 3) should be located ahead of the aircraft, and the "LOC" (localizer) symbol should be centered if a localizer or ILS is available and its frequency has been selected.

Runway centerline lighting and runway edge lighting also should conform to pilot expectations for the takeoff runway, based on review of the airport diagram. The SAFO also recommends that the flight crew, *after* initiating the takeoff roll, verbalize the lineup check a final time by performing a challenge-response standard call such as "Active runway check. — Active runway checked." FAA Advisory Circular 120–74A, "Flight Procedures During Taxi Operations," and SAFO 07003, "Confirming the Takeoff Runway," similarly emphasize the importance of coordination using all available resources.

While conducting the approach, positive visual identification of the assigned runway — particularly when landing on one of the parallel runways — requires checking internal and external cues including raw data from navaids, such as the "LOC" symbol centered if a localizer or ILS is available and the frequency has been selected. Other vital cues are the assigned runway heading; all visible runway characteristics including width, length, approach lighting and runway lighting expected; indications of traffic conflict on the ATC tower frequency; and a visual check — whenever possible — that no aircraft is holding in the takeoff position.

Michel Trémaud retired from Airbus as senior director and head of safety programs/initiatives. His career also included positions at Aerotour, Air Martinique and Bureau Veritas.

Typical Lineup Check Using Navigation Display



Navigation display in "ARC" Mode

To be used when the SID is entirely ahead of the departure runway heading

Navigation display in "ROSE" Mode

To be used when the SID is partly opposite to the departure runway heading

SID = standard instrument departure

Source: Michel Trémaud

Figure 3

Mounting evidence confirms that publication of airport hot spots raises runway-safety threat awareness, several U.S. specialists say. Noting successes at sites where runway incursions have dropped significantly, an ongoing standardization initiative by the U.S. Federal Aviation Administration (FAA) has created a single national process for generating hot-spot notifications to aircraft operators, pilots, airfield drivers and air traffic controllers. These official notifications coexist with informal educational media, which for the first time are available from a central repository on the agency's Web site.

The International Civil Aviation Organization (ICAO) defines *hot spot* as "a location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary."[1] Its standards and recommended practices, amplified three years ago, have prompted similar steps by civil aviation authorities in a number of other countries, such as Canada and France.

ICAO emphasizes that flight crews should prepare well in advance for departure and arrival at any airport, including reviewing hot spots before taxiing from the gate and prior to beginning descent. "The 'before start' and 'descent' briefings also should contain a complete review of the expected taxi routes with special attention to the hot spots," its guidance says. "Special attention should be paid to temporary

HOT SPOT Intelligence

Standardization adds cautionary notes to more U.S. airport diagrams and airport/facility directories.

BY WAYNE ROSENKRANS

© Jonathan Zaniger/Airliners.net

situations such as work in progress, other unusual activity and recent changes in the aerodrome layout."

At a minimum, local runway safety teams should parlay lessons from accident/incident reports into identifying hot spots and producing "hot spot maps" using criteria such as those provided in the international guidance. "Hazards associated with hot spots should be mitigated as soon as possible and so far as is reasonably practicable," ICAO says. "Aerodrome charts showing hot spots should be produced locally, checked regularly for accuracy, revised as needed, distributed locally, and published in the [national] aeronautical information publication."[2]

Last year, the FAA introduced a 56-day cycle of delivery for its two hot spot resources in flight information publications. They comprise symbols and text on airport diagrams (Figure 1, p. 22) within the *Terminal Procedures Publication* and descriptions and airport diagrams in airport/facility directories.

"Hot spots are depicted on airport diagrams as open circles designated as 'HOT^{1}, HOT^{2}, etc.' and tabulated … with a brief description of each hot spot," the agency said. "Hot spots will remain charted on airport diagrams until such time as the increased risk has been reduced or eliminated."[3]

This year, a new policy on required content of airport diagrams — adding hot spots — has been introduced, and the *Runway Safety Hot Spots List* has enabled a selection of 84 hot spot charts, brochures, kneeboard pages and posters to be downloaded from <www.faa.gov/airports/runway_safety/hotspots/hotspots_list/>.

"Typically, [a hot spot] is a complex or confusing taxiway-taxiway or taxiway-runway intersection," the FAA says. "The area of increased risk has either a history of or a potential for runway incursions or surface incidents due to a variety of causes such as, but not limited to, airport layout; traffic flow; airport marking, signage and lighting; situational awareness; and training." Potential confusion typically is identified by interviewing groups of local users.

The FAA Air Traffic Organization's *Annual Runway Safety Report 2009* last October said, "The use of labels for hot spots on all [airport] diagrams will make it easier for users of an airport to plan the safest possible path of movement in and around that airport. … Proper planning helps avoid confusion by eliminating last-minute questions and building familiarity with known problem areas. While some airports voluntarily labeled hot spots on proprietary versions of their airport diagrams in the past, officially accepted standards for such labeling did not exist."

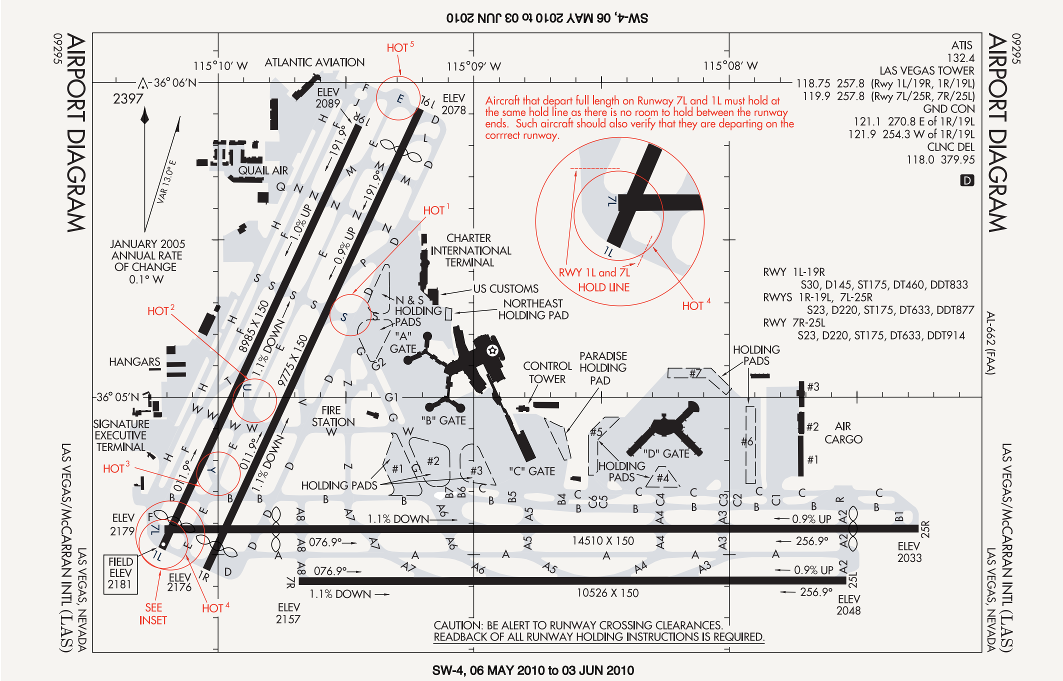
Historical Context

The U.S. drive to introduce this safety tactic began during 2001 and 2002 as a runway-incursion countermeasure at North Las Vegas Airport, Las Vegas McCarran International Airport and Phoenix Sky Harbor International Airport, recalls Chris Diggons, assistant manager, runway safety, FAA Western-Pacific Region. "The first Jeppesen airport diagram with hot spot information was for Chicago O'Hare International Airport in April 2001," Diggons said, and the list of U.S. airports with at least one hot spot depicted by Jeppesen has grown to 154.

Airport operators were the first interest group to request that Jeppesen add hot spots to its U.S. airport diagrams. Managers from FAA regional runway safety program offices later requested them and, on rare occasions, an air carrier or pilot group also requested them, said Michael Pound, a corporate communications representative at Jeppesen. "We encouraged the airlines and pilots to contact the airport and/or a regional runway safety program office to ensure that [everyone] who had knowledge of all issues related to potential problems with ground movement maintained a manageable paper trail," Pound said. In 2009, FAA National Aeronautical Navigation Services, formerly the National Aeronautical Charting Office, developed and implemented a hot spot charting specification, he said.

Jeppesen also submitted its list to the FAA and asked the agency to synchronize all the U.S. hot spot information, Pound said. "Sourcing all hot spot descriptions now through the National Flight Data Center provides a method to harmonize any discrepancies that might arise," he said.

Example of Hot Spot Depiction on Airport Diagrams



Note: Text and symbols shown in red are black on actual airport diagrams.

Source: U.S. Federal Aviation Administration

Figure 1

In 2003, the FAA Office of Runway Safety began formalizing its hot spot process. "We have been working on that process ever since," Diggons said. Before official hot spots were introduced, sources for airport users were the Jeppesen airport diagrams or informal educational products of the FAA Office of Runway Safety. Because the unofficial products have no update cycle, however, they are marked "not for navigation," meaning that pilots also must review current airport diagrams.

Another distinction is that official descriptions focus concisely only on the type of risk and general action to take, Diggons said. This practice conforms to specifications designed to reduce the chance of a pilot or airfield driver deviating from air traffic control instructions, which take precedence. For hot spot charts and brochures, regional managers are not bound by those specifications, allowing more latitude to describe lessons learned at the location with photographs and explanatory details.

The FAA's policy on airport diagram content — Air Traffic Organization Order JO 7910.4D, "Airport Diagrams," effective May 3, 2010 — makes the depiction of hot spot symbols mandatory if available. The policy says airport diagrams will have the "location of hot spot(s) on movement areas with a description of the potential safety problem(s) that exist."

"The policy itself does not have a detailed process within it for hot spots," Diggons said. "We have a standalone document in which the FAA's Office of Runway Safety and National Aeronautical Navigation Services have determined how to submit hot spots for publication."

Under the FAA Air Traffic Organization's safety management system, adding a new hot spot to any airport diagram typically triggers a runway-safety action team visit by regional specialists and creates a high-priority entry in the national Runway Safety Action Plan database, except when these actions already have been taken. "The Airports Division considers a hot spot a safety issue, and provides it a high priority among upcoming improvement projects for the airport," he said.

Various factors have influenced successful introductions of hot spots in the FAA's Western-Pacific Region. North Las Vegas was "no. 1 on the hit parade" of runway incursions until the runway safety team developed a series of hot spot brochures, Diggons recalled. "With hot spots now on their airport diagram, they are off the high-risk horizon — back down to a more average runway-incursion rate."

At McCarran, a hot spot was added to counteract a wrong-runway departure risk in which the geometry of Runways 1L and 7L was prone to pilot confusion, he added. "Report-wise, we have not had any more confusion," Diggons said.

"San Francisco has a confusing intersection at a 90-degree angle where aircraft pilots failed to make the appropriate turn and proceeded up the reverse high-speed taxiway where they came nose-to-nose with oncoming departing and arriving traffic at Runway 28L. That hot spot went into both Jeppesen and FAA products, and we haven't had any repeats of that so arguably we can say that the hot spot publication did the job … for so long that they are considering removing the hot spot."

By identifying hot spots and making two changes to signage, both to prevent pilot deviations, Tucson (Arizona) International Airport also became a model of success. "About 20 percent of pilot deviations were happening at a specific set of intersections for which we now have published hot spots; they no longer have those," Diggons said.

Serious runway incursions recently identified in the FAA's Northwest Mountain Region led to airport construction and publication of hot spots at Pueblo (Colorado) Memorial Airport and Billings (Montana) Logan International Airport, he noted. "The hot spots will be removed in early 2011 when their construction projects are finished," he said. Normally, the FAA is reluctant to remove hot spots, but Pueblo and Billings involved an exceptional temporary pattern linked directly to changes to its airport geometry and signs, so the decision is straightforward compared with San Francisco where "nothing appreciable" has been done to the layout, he said.

In some cases, a change of runway-taxiway-intersection geometry eliminates a hazard or significantly reduces a risk, said Chris Pokorski, a safety engineer in the Office of Runway Safety. "We had one at Milwaukee [Wisconsin] General Mitchell International Airport where Taxiway Mike led right to the approach end of Runway 25L at an acute angle. That was a hot spot for a long time. They ended up changing the geometry so Taxiway Mike ends in a more normal, right-hand turn onto Taxiway November before pilots get to the approach end of Runway 25L. That eliminated the runway incursions at that intersection, so they have taken the hot spot off the airport diagram."

Unforeseen Consequences

Updated dimensions of precision obstacle-free zones of some runways with precision instrument approaches last year unintentionally became a factor causing low-severity runway incursions, Pokorski said. "Numerous airports had to move their runway holding position markings quite a way farther back from the approach end of the runway — to an unusual hold position, one unexpected by air crews," he said. "They would routinely cross the new 'hold-short line' because they expected it in a more normal position."

Airport diagrams normally do not depict these markings, but the runway safety team for Manchester (New Hampshire) Boston Regional Airport requested that an exception be granted after 12 runway incursions occurred at the new "hold-short line" for Runway 17, he said. Other pilots were confused when the same marking was added to Taxiway Papa about 800 ft (244 m) from the approach end of Runway 35, compared with its previous location about 250 ft (76 m) away on Taxiway Uniform. The FAA added a "RWY HOLD LINE" label and dashed line to the airport diagram for Runway 17. With this change, and air traffic controllers instructing pilots to hold short at Taxiway Lima for Runway 17 departures, the runway incursions have been reduced to about one per year. Adding one or more hot spots in similar situations has been the best solution for other U.S. airports, however, Pokorski added. Diggons said, "Hot spots are in more common use, and airports are getting in line in recognizing the importance of hot spots to aviation safety."

Jeppesen's electronic airport diagrams support pilot briefings by incorporating hot spots derived from the same National Flight Data Center source as its paper chart service and the FAA's online versions. Plans call for hot spots to become a real-time resource to further increase situational awareness, Pound says.

"It is entirely possible, if not likely, that hot spots will be depicted in the Jeppesen Airport Moving Map application in the near future," he said. "However, there are issues to resolve first, including the use of color. Airframe manufacturers use certain colors to classify information presented on flight deck [displays], which has an impact on the use of color in this application. These are human factors concerns, and Jeppesen is experimenting with options that would meet the requirements of the original equipment manufacturers." Other companies also obtain hot spots from the National Flight Data Center or National Aeronautical Navigation Services.

Notes

1. ICAO. Annex 4, *Aeronautical Charts*. 11th edition, July 2009.
2. ICAO. *Manual on the Prevention of Runway Incursions*. Doc 9870 AN/463. First Edition, 2007.
3. FAA. *Airport/Facility Directory, Southwest Region*. Effective April 8, 2010, to June 3, 2010.

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THRUST INTO

Tire debris disabled sensors, causing a Learjet 60 to accelerate during a high-speed rejected takeoff.

BY MARK LACAGNINA

The captain's decision to reject the takeoff after the airplane had accelerated beyond V_1 and electronic system damage that resulted in forward thrust being produced when reverse thrust was selected are among the issues discussed by the U.S. National Transportation Safety Board (NTSB) in its final report on the fatal crash of a Learjet 60 in Columbia, South Carolina, U.S., on Sept. 19, 2008.[1]

Based on findings that severely underinflated tires burst during the takeoff and shed debris into the wheel wells, damaging critical electronic sensors and hydraulic lines, the report also discusses the importance of, and

AN OVERRUN

procedures for, maintaining proper tire inflation (see "Pressure Check," p. 30).

The accident occurred in visual meteorological conditions shortly before midnight during an attempted takeoff from Runway 11 at Columbia Metropolitan Airport. The Learjet, with six people aboard, overran the 8,601-ft (2,622-m) runway and the 1,000-ft (305-m) runway safety area (RSA) during the rejected takeoff (RTO). It then struck several objects before stopping against a roadside embankment. The airplane was destroyed by impact forces and an intense fire. Two passengers and the pilots were killed, and two passengers were seriously injured.

The report said that the probable causes of the accident were "the operator's inadequate maintenance of the airplane's tires, which resulted in multiple tire failures during [the] takeoff roll due to severe underinflation, and the captain's execution of an RTO after V_1, which was inconsistent with her training and standard operating procedures [SOPs]."

Moreover, the report said that contributing factors were "deficiencies in Learjet's design of and the Federal Aviation Administration's (FAA) certification of the Learjet Model 60's thrust reverser system, which permitted the failure of critical systems in the wheel well area to result in uncommanded forward thrust that increased the severity of the accident; the inadequacy of Learjet's safety analysis and the FAA's review of it, which failed to detect and correct the thrust reverser and wheel well design deficiencies after a 2001 uncommanded forward thrust accident; inadequate industry training standards for flight crews in tire failure scenarios; and the flight crew's poor crew resource management (CRM)."

The Learjet, which had accumulated 106 flight hours since its manufacture in 2006, was among nine airplanes operated by Global Exec Aviation, a charter-service provider and aircraft-management company based in Long Beach, California. The company employed 11 full-time pilots.

'Excellent References'

The captain, 31, was hired in January 2008. The company's director of operations told investigators that a simulator evaluation typically required for new hires was waived because of her excellent references. "Interviews with other pilots, a Learjet 60 proficiency-check evaluator and flight- and ground-training instructors who were familiar with the captain's flying and training in recent years revealed that none expressed any concerns about the captain's competence," the report said.

She had 3,140 flight hours, including 2,040 hours as pilot-in-command (PIC). She earned a Learjet 60 type rating in October 2007 and also held type ratings for the Cessna Citation 500 and Citation 650. She had 35 hours in the Learjet 60, with about eight hours as PIC. "In the 30 days before the accident, the captain had accumulated about 19 hours as second-in-command (SIC) in the Learjet 60 and about 15 hours as PIC in the Cessna CE-650," the report said.

The first officer, 52, was hired as a part-time pilot the month before the accident. He had about 8,200 flight hours, including about 7,500 hours as PIC. He had 300 hours in Learjet 60s, with 192 hours as PIC. He also held a Citation 500 type rating. The first officer was described by Global Exec Aviation's director of operations as "a well-experienced pilot with excellent piloting skills."

The pilots previously had flown together twice. Two days before the accident, they commuted on an airliner from Long Beach to Teterboro, New Jersey, where maintenance had been completed on a high-pressure bleed valve in the accident airplane. They conducted a 48-minute

The thrust reverser doors deployed, as shown here, but then were inadvertently stowed, and the engines produced nearly full forward thrust.

Bombardier Learjet 60

Deliveries of the Learjet 60 midsize business jet began in 1993. Compared with its predecessor, the 55C, the 60 has more powerful engines, wing modifications to improve aerodynamic performance, upgraded avionics equipment, a longer fuselage and a larger baggage compartment.

The airplane can accommodate two pilots and eight passengers. The Pratt & Whitney Canada PW305A turbofan engines are flat-rated at 20.46 kN (4,600 lb) thrust. Maximum weights are 23,500 lb (10,660 kg) for takeoff and 19,500 lb (8,845 kg) for landing.

Balanced field length for takeoff is 5,450 ft (1,661 m). Maximum rate of climb at sea level is 4,500 fpm, or 1,240 fpm with one engine inoperative. Maximum operating speeds are 340 kt at Flight Level (FL) 200 (approximately 20,000 ft), 0.81 Mach at FL 370 and 0.78 Mach above FL 430. Maximum operating altitude is FL 510. Range with reserves is 2,493 nm (4,617 km).

The Learjet 60 remained in production until 2007, with 314 built before the model was replaced by the 60XR, which has a redesigned cabin, upgraded avionics and other improvements.

Sources: Bombardier Aerospace, *Jane's All the World's Aircraft*

test flight of the Learjet that day and departed from Teterboro the next day at 2142 local time for a positioning flight to Columbia, where they were to pick up the passengers for a charter flight to Van Nuys, California.

The pilots' mobile telephone records indicated that fatigue may have played a role in the accident, but this was not confirmed by investigators. The records showed that on the night before the accident, the captain "had the potential for 7.5 to 9.5 hours of sleep" and that the first officer "had the potential for 9.75 hours of sleep," the report said. Records for the next day indicated that there were few and relatively brief periods in which the pilots did not use their mobile telephones before leaving the hotel at 2018.

Lack of Focus

The Learjet arrived in Columbia at 2310. Surface winds were from 060 degrees at 10 kt, visibility was 10 mi (16 km), the sky was clear, and the ambient temperature was 21° C (70° F) when the passengers were boarded. Runway 05/23 was closed for construction.

The report pointed to several examples of ineffective CRM, including lack of accuracy about RTO criteria during the captain's preflight briefing, exchanges of incorrect and unchallenged information between the pilots, incorrect readbacks of air traffic control instructions and a wrong turn while taxiing. Neither pilot appeared to be "particularly focused," the report said. "The captain's casual tone and lack of leadership, and the flight crew's inattention to details foreshadowed elements of the crew's subsequent performance in responding to the [takeoff] anomaly."

The pilots apparently did not conduct weight-and-balance calculations. "Although postaccident estimates indicated that the airplane's maximum gross weight may have been exceeded by up to 300 lb [136 kg], there is no evidence that weight-and-balance issues contributed to the accident," the report said.

Among the airspeeds set for takeoff from Columbia were 136 kt for V_1 and 145 kt for rotation. The report said that the crew had been taught — and the company's SOPs specified — that "because of the high risk of runway overrun and other dangers, rejecting a takeoff at speeds greater than V_1 should be performed only when airplane control is seriously in doubt."

'Loud Rumbling Sound'

The captain, the pilot flying, began the takeoff at 2355. Less than two seconds after the first officer made the V_1 callout, the cockpit voice recorder (CVR) recorded a "loud rumbling sound," and the airplane veered right. The sound was attributed to fragments of the right outboard tire, which failed first, striking the bottom of the airplane.

The first officer said, "Go." The captain, who had regained directional control after the swerve, said something unintelligible, and the first officer said, "Go, go, go."

Airspeed had reached a peak of 144 kt when the captain said, "Go?" She had reduced power briefly but then increased power for about one second before reducing it again.

"No?" the first officer said. "All right. Get, ah, what the [expletive] was that?"

"I don't know," the captain replied. "We're not going, though." She then said "full out," likely indicating deployment of the thrust reversers, and applied wheel braking.

'Startle Factor'

Investigators found no sign that the Learjet was not controllable. Attempting to explain why the captain did not follow her training and SOPs, the report said that she likely was startled by the airplane's swerve, the sound of the tire fragments striking the airplane and the vibration of the airframe caused by the burst tires.

The "startle factor" does not exist in simulated training scenarios but "in the real world … can increase the stress levels of the pilot, resulting in an incorrect decision being made," the report said. "Many other pilots have misinterpreted tire anomalies and responded by initiating an unnecessary RTO after V_1."

The thrust reverse malfunction caused the engines to produce high forward thrust, and the Learjet, which had been decelerating, began to accelerate.

The first officer radioed the airport traffic controller, saying, "Roll the equipment. We're going off the end." The CVR recording ended less than four seconds later — 41 seconds after the takeoff was initiated.

The report said that after overrunning the RSA, the Learjet "struck airport lighting and navigation antennas, and descended a steep downhill slope before striking a lighting pole and the perimeter fence. The airplane then struck a concrete highway marker post, crossed a five-lane road and struck a second concrete post and an embankment on the far side of the road."

The controller told investigators that the airplane "exploded into a fireball" after coming to a stop.

The survivors, who were in the aft seats, escaped through the emergency exit in the lavatory, which is in the rear of the cabin. Both men sustained second- and third-degree burns.

Diphenhydramine, an allergy remedy and sleep aid, was detected in samples from the bodies of both pilots. The report said, however, that there was insufficient evidence to determine if the use of this drug — or

The thrust reverse levers are hinged to, and atop, the thrust levers.

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possibly fatigue — had impaired their performance.

Sensors Disabled

The report said that the tires had burst during the takeoff because of sidewall overdeflection and that tire fragments thrown into the wheel wells had struck and disabled components of the thrust reverser system, as well as hydraulic lines.

The Learjet 60's engines and thrust reverser system are controlled electronically, with no "mechanical or cable-actuated connection between the cockpit thrust levers and the engines," the report said. To select reverse thrust, the pilot moves the thrust levers to the idle stops and then lifts and pulls the thrust reverse levers, which are hinged to, and atop, the thrust levers.

Microswitches detect which levers the pilot is using. When the thrust reverse levers are lifted, electronic signals command the thrust reverser doors to deploy. The two half-shell doors, which form the top and bottom of the aft portions of the engine nacelles when stowed, move aft and join together to form barriers that redirect the engine fan airflow and exhaust gases forward, thus producing "reverse thrust."

Among safeguards against inadvertent deployment of the thrust reversers during flight are squat switches on each main landing gear assembly. When the gear is extended and the assemblies are compressed to support the airplane's weight, the squat switches signal the electronic engine control (EEC) system that the airplane is in "ground mode," allowing the thrust reversers to deploy.

The deceleration that occurred after the captain called "full out" indicates that the thrust reversers initially operated normally. However, the CVR then recorded the nosewheel steering disconnect warning tone, an indication that the mode status had changed from ground to air.

The investigation determined that one or both squat switches had been disabled during the accident sequence. "Debris found on the runway and other physical evidence show that the MLG [main landing gear] area where system components were mounted sustained damage from the shedding tire fragments," the report said.

The false air mode indication caused the thrust reversers to stow and triggered an EEC logic shift and a change from the reverse-thrust power schedule to the forward-thrust power schedule. The engines began to produce forward thrust at near takeoff power when the Learjet was about 2,500 ft (762 m) from the end of the runway. Reducing thrust would have required moving the thrust reverse levers to the stowed position — an action that is counterintuitive during an RTO, the report said.

Airspeed was more than 100 kt when the airplane overran the RSA. Because wheel braking effectiveness was compromised by the burst tires and by hydraulic system damage, "it was not possible to determine whether or not the flight crew could have safely stopped the airplane on the runway (or within the RSA) had the airplane not developed the uncommanded forward thrust," the report said.

Design Change Needed

The Columbia accident was similar to an accident that occurred on Jan. 14, 2001, when a Learjet 60 struck two deer shortly after touchdown at Troy (Alabama, U.S.) Municipal Airport.[2] The investigation revealed that deer fur lodged in a squat switch, rendering it inoperative. The thrust reversers stowed, and the EEC switched to a forward-thrust schedule. Despite heavy wheel braking, the airplane overran the 5,010-ft (1,527-m) runway. Both pilots were seriously injured.

The airplane manufacturer introduced an emergency procedure for inadvertent thrust reverser stowage after the 2001 accident, but the FAA did not require modification of the system design to prevent uncommanded production of forward thrust during an RTO.

A redesign of the thrust reverser system and training Learjet 60 pilots to recognize inadvertent thrust reverser stowage were among several recommendations generated by the Columbia accident investigation (*ASW*, 8/09, p. 10). The FAA has responded in part by publishing Safety Alert for Operators 09017, which outlines best practices for recognizing and responding to cockpit indications of inadvertent or uncommanded thrust reverser stowage during an RTO or a landing in a Learjet 60 or 60XR.

This article is based on NTSB Accident Report AAR-10/02: "Runway Overrun During Rejected Takeoff; Global Exec Aviation; Bombardier Learjet 60, N999LJ; Columbia, South Carolina; September 19, 2008." The full report is available at <ntsb.gov/Publictn/A_Acc1.htm>.

Notes

1. U.S. Federal Aviation Regulations Part 1.2 defines V_1 as follows: "V_1 means the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance. V_1 also means the minimum speed in the takeoff, following a failure of the critical engine at V_{EF}, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance." (V_{EF} is "the speed at which the critical engine is assumed to fail during takeoff.")
2. NTSB Accident Report ATL01FA021.

Many pilots and maintenance technicians don't realize that routine tire-pressure checks are crucial to safe operations.

Pressure Check

BY LINDA WERFELMAN

© Chris Sorensen Photography

Some operators are unaware of appropriate tire-pressure check intervals and, as a result, are flying airplanes with dangerously under-inflated tires, the U.S. National Transportation Safety Board (NTSB) says, citing the fatal crash of a Bombardier Learjet Model 60 that was attributed to poor tire maintenance (“Thrust Into an Overrun,” p. 24).[1]

Tire pressures on the accident airplane had not been checked for about three weeks before the Sept. 19, 2008, accident in Columbia, South Carolina, U.S., the NTSB said. Multiple tire failures — a result of “severe under-inflation” — occurred during the takeoff roll, prompting the crew to reject the takeoff, but the airplane overran the runway safety area and crashed. Both crewmembers and two passengers were killed; the other two passengers were seriously injured, and the airplane was destroyed.

The accident investigation found that the four main landing gear tires — Goodyear Flight Eagle, part no. 178K43-1 — had been installed in December 2007 and, at the time of the accident, had accumulated 20 landings. Their rated tire inflation pressure was 220 psi (15.2 bar).

According to tire performance criteria outlined in a number of documents, including U.S. Federal Aviation Administration (FAA) Technical Standard Order TSO-C62c, the maximum allowable tire pressure loss is 5 percent per day; Goodyear tests showed that the type of Flight Eagle tire installed on the accident airplane had a documented daily pressure loss of 2.2 percent.

The accident report said maintenance logs for the Learjet indicated that, during the 12 days preceding the accident, the airplane had been flown on five days.

“Interviews with personnel from all facilities that handled the accident airplane during that time period revealed that none had serviced or received a request to service the MLG [main landing gear] tires,” the report said.

Subsequent tests showed that the MLG tires were under-inflated by about 36 percent. The NTSB report noted that the aircraft maintenance manual called for a tire to be replaced if it was operated with a pressure deficit of 15 percent or more.

Excess Heat Hurts

The tires of transport category airplanes typically are made from rubber, flexible nylon ply or some similar material, and steel bead wires, and are filled with nitrogen. They operate with high inflation pressures and are designed to withstand the heavy load requirements and high speeds that prevail during takeoff and landing.

As the tires rotate, they produce heat, largely because of the friction generated during tire deflection — the shifting of the axle-to-ground distance after a tire is installed.[2] Tires function properly when they are correctly inflated and not overloaded. However, when they are under-inflated or overloaded, tires tend to over-deflect.

“When a tire’s sidewalls over-deflect at the bottom of each rotation, the excessive flexing of the rubber can result in fatigue of the reinforcing fibers and the generation of higher internal temperatures at a faster rate than would be generated in a properly inflated, properly loaded tire,” the report said. “High temperatures can degrade the physical properties of the tire’s rubber compounds and melt the nylon threads in the plies; such damage can lead to tire failure.”

Instructions for “daily or regular” checks of tire pressure are included in many aircraft maintenance manuals and tire maintenance documents, and the accident report cited such instructions in the Learjet 60 maintenance manual and other Learjet and Goodyear tire maintenance publications, as well as FAA Advisory Circular (AC) 20-97B, *Aircraft Tire Maintenance and Operational Practices*.[3]

On the Learjet 60, checking tire pressure is considered a job for maintenance personnel, not flight crewmembers, and requires the technician to “crouch or crawl under the wing of the airplane to gain access to the MLG tire pressure valves,” the report said. “The landing gear doors may conceal the valves for the outboard tires, requiring a person to lie on the ground to gain access.”

The accident report quoted Global Exec Aviation's director of operations as saying that the Learjet 60 airplane flight manual (AFM) did not specify that daily tire pressure checks were necessary and that the company's pilots did not check the tire pressure and were not required to do so. At the time of the accident, the company's preflight procedures called for the flight crew to "check" the main landing gear wheels, tires and brakes, and the AFM prescribed a check of their "condition"; neither instruction called specifically for a check of tire pressure.

The report said that Learjet 60 pilots and instructors interviewed by accident investigators said that "preflight tasks involved visually inspecting the tires for general condition, such as excessive wear, sidewall bulges or visible tire cord. All but one pilot interviewed stated that tire under-inflation would be difficult to determine visually (one thought that 'significant' under-inflation could be visually detected). All but one of the Learjet 60 pilots and instructors interviewed stated that checking tire pressure was a maintenance function and that they were neither trained nor expected to check tire pressure at any time."

The director of maintenance at Global Exec Aviation told investigators that he did not know how often the pressure of the tires on the Learjet 60 was to be checked and that there was no requirement to maintain a written record of the checks. He said that he referred to the aircraft maintenance manual to determine when such maintenance items were to be performed.

5 Percent

The NTSB said, in its accident report and accompanying safety recommendations, that even if the tires on transport category airplanes lose 5 percent pressure every day, the pressure loss is not visible and can be detected only with tire pressure checks.

Because of the rapid pressure loss, "It may take only a few days for such tires to reach an under-inflation level below what the aircraft maintenance manual specifies for tire replacement," the NTSB said.

The NTSB recommended that the FAA tell pilots and maintenance personnel about the potential for tire pressure loss and its consequences. Other NTSB recommendations called on the FAA to require all air carriers, commuter and on-demand operators, and fractional-ownership operators to "perform tire pressure checks at a frequency that will ensure that the tires remain inflated to within aircraft maintenance manual–specified inflation pressures."

In addition, the NTSB said that the FAA should require aircraft maintenance manuals to specify, "in a readily identifiable and standardized location, required maintenance intervals for tire pressure checks, as applicable to each aircraft."

Pilots of aircraft operating under U.S. Federal Aviation Regulations Part 135, "Commuter and On-Demand Operations"; Part 91, "General Operating and Flight Rules"; and Part 91K, "Fractional Ownership Operations," should be permitted to check tire pressure, and tire-pressure monitoring systems should be required for all transport category airplanes, the NTSB said.

The accident report, noting that checking tire pressure was not a task assigned to the pilots of the Learjet, said that they "had no means by which to detect the accident airplane's under-inflated tires." If they had suspected that the tire pressure might have been low, they could have requested service from the same facility that was performing other maintenance before the airplane was repositioned for the accident flight, the report said.

A tire-pressure monitoring system would have provided the pilots with such information, the report said, noting that after the accident, officials from Learjet and Global Exec Aviation said that they were considering the installation of a monitoring system.

The systems consist of "a wireless pressure and temperature sensor built into the tire's inflation stem to facilitate the ease, accuracy and automatic documentation of the aircraft daily tire pressure check," the report said. Typical monitoring systems transmit tire pressure readings to the flight deck for display and include visual and/or aural warnings in case of abnormal pressure readings.

Another recommendation said that the FAA should "require that tire-testing criteria reflect the actual static and dynamic loads that may be imposed on tires both during normal operating conditions and after the loss of one tire, and consider less-than-optimal allowable tire conditions including, but not limited to, the full range of allowable operating pressures and acceptable tread wear."

FAA Instructions

Before the release of the accident report, the FAA issued a safety alert for operators (SAFO) discussing the dangers of improperly inflated tires and providing guidance for averting such problems.[4]

"The average aircraft tire is composed of 50 percent rubber, 45 percent fabric and 5 percent steel," the FAA said. "These tires are designed to carry heavy loads at high speeds. Problems caused by incorrect tire pressure can lead to catastrophic failure of the tire(s). Over-inflation of a tire can cause uneven tread wear, reduced traction, make the tread more susceptible to cutting, and can increase the stress on aircraft wheels. Under-inflation of a tire can cause uneven tire wear and greatly increases stress and flex heating in the tire, which shortens tire life and can lead to tire blowouts."

The FAA said that the Learjet accident was only one of a number of accidents that may have involved "malfunctioning aircraft tires" and added, "It is imperative pilots understand the dangers of improperly inflated tires."

The SAFO recommended that pilots or maintenance personnel check tire pressure according to the manufacturer's "recommended intervals and procedures." The pressure checks should be "cold" checks conducted with a calibrated pressure gauge after tires have been at rest for at least two hours, the SAFO said.

The SAFO did not alter the information provided by the FAA in AC 20-97B, which also emphasizes that "accurately maintaining the correct inflation pressure is the single most effective task in the preventive maintenance regimen for safe tire operations."

The AC prescribes daily checks of tire pressure using a calibrated gauge, with measurements accurate within plus or minus 2 percent for the tire operating range, to check "cold" tire assemblies — those that are at ambient temperature or that have not been in service for at least two hours.

During the daily pressure checks, any tire assembly with between 90 and 100 percent of the minimum loaded service pressure — service pressure is defined as "the inflation pressure needed to support the maximum operating load for a wheel position" — should be re-inflated.

However, a tire assembly should be removed from service if a pressure check indicates that it has been operated at less than 90 percent of minimum loaded service pressure, the AC says, and if an assembly has been operated at less than 80 percent of the minimum loaded service pressure, that assembly and its axle-mate should both be removed from service. Tires removed from service should either be scrapped on the site or taken to a full-service repair facility, along with written documentation of why they were removed from service.

U.S. National Transportation Safety Board

Reconstruction of a tire from the accident airplane shows outboard sidewall damage. The yellow arrows are intended to depict what the NTSB called "the generally uniform location of the damage."

Because of the high inflation pressures and high loads, the FAA said that aircraft tires "can be easily damaged when rolled over hard objects that protrude above a paved surface." In some cases, the resulting damage is superficial, but at other times, a sharp object can penetrate the tire casing and cause a loss of tread; penetration of the tread can cause "loss of inflation integrity and over-deflection of the tire," the FAA added.

Notes

1. NTSB. Safety Recommendations A-10-46 through A-10-59. April 14, 2010. Also, NTSB. *Runway Overrun During Rejected Takeoff, Global Exec Aviation, Bombardier Learjet 60, N999LJ, Columbia, South Carolina, September 19, 2008.*

2. FSF Editorial Staff. "Monitoring Aircraft-tire Pressure Helps Prevent Hazardous Failures." *Aviation Mechanics Bulletin* Volume 47 (March–April 1999): 1–13.

3. FAA. AC 20-97B, "Aircraft Tire Maintenance and Operational Practices." April 18, 2005.

4. FAA. SAFO 09012, "Dangers of Improperly Inflated Tires." June 12, 2009.

Further Reading From FSF Publications

FSF Editorial Staff. "Managing Aircraft-tire Wear and Damage Requires Adherence to Removal Limits." *Aviation Mechanics Bulletin* Volume 47 (May–June 1999): 1–12.

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BY LINDA WERFELMAN

STEPPING

Use of strategic lateral offset procedures on crowded routes across the North Atlantic has increased significantly in the past two years, according to data compiled by air navigation service providers that handle air traffic in the area.

For aircraft that reported their positions via automatic dependent surveillance–contract (ADS–C)[1], data showed that from October through December 2009, about 40 percent were using offset procedures, which allow pilots to fly parallel to an airway centerline and either 1 nm or 2 nm to its right (Figure 1). The procedures are available to pilots of aircraft in "oceanic and remote" airspace between Flight Level (FL) 290 (approximately 29,000 ft) and FL 410 — the airspace in which reduced vertical separation minimum (RVSM) procedures have cut the standard vertical separation of aircraft from 2,000 ft to 1,000 ft.

The 40 percent figure for use of offset procedures compares to 10 percent in 2007 and to 2 percent in 2005, said Gavin W. Dixon, local area supervisor and safety coordinator in the U.K. NATS[2] Prestwick Centre, one of several air traffic control centers that handle North Atlantic traffic. Dixon said that NATS officials are "encouraged by the steady increase in usage," which has continued in early 2010.

Strategic lateral offset procedures were first developed by the International Civil Aviation Organization (ICAO) in an attempt to reduce collision risks after the initial implementation of RVSM in 1997. Later, the aviation community recognized that the offsets offered another benefit: reduced exposure to wake turbulence.

ICAO's *Procedures for Air Navigation — Air Traffic Management* document discusses the mitigating effects of offsets on both collision risks and wake turbulence and says that flight crews are responsible for deciding whether to apply a lateral offset, as long as offset procedures are authorized by the appropriate air traffic services authority and the aircraft is equipped with automatic offset tracking capability. Routes on which the offsets are used may be uni-directional or bi-directional, or parallel routes with airway centerlines that are at least 55.5 km (30 nm) apart.[3]

welcomed, but further expansion is still being encouraged."

Mark Seal, a United Airlines captain and regional vice president of the International Federation of Air Line Pilots' Associations (IFALPA) for the North Atlantic, said that, because of the increasing use of offset procedures, "the collision risk level is being reduced every day."

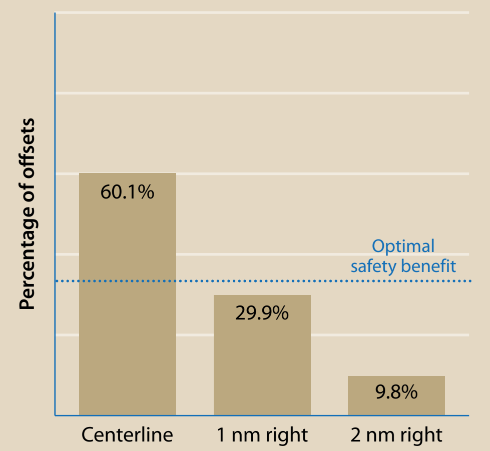
An increasing number of airlines have either incorporated the use of offset procedures into their oceanic and remote airspace operating procedures or have strongly encouraged their pilots to implement the procedures, Seal said, adding that pilots have become more informed about the safety benefits of using offset procedures.

He also said that the "randomization" introduced by pilot choices of either the centerline or a 1 nm or 2 nm offset to the right of centerline has increased.

Nevertheless, data compiled for North Atlantic flights for the last three months of 2009 showed that 30 percent of aircraft were being flown on a 1 nm right offset and 10 percent on a 2 nm right offset.

"The procedure provides maximum safety advantage when roughly a third of aircraft are

North Atlantic Use of Strategic Lateral Offset Procedures



Source: U.K. NATS

Figure 1

ASIDE

Surveys measure an increase in pilots' use of strategic lateral offset procedures.

A document produced by U.K. NATS researchers in late 2009 characterized the offset procedures as "priceless in terms of safety when applied correctly, significantly reducing the vertical collision risk."[4]

Expansion Encouraged

Larry Lachance, assistant vice president, operational support, at Nav Canada, agreed that, "given the safety benefits of decreasing lateral overlap probability and reducing the likelihood of wake vortex encounters for aircraft, the increased usage of strategic lateral offset procedures is using each offset (i.e., 66 percent of aircraft away from the center line)," the NATS document said. "These … comparative figures of 40 percent current usage and a 66 percent target fail to highlight the importance of the *equal* distribution across the three options. For example, three aircraft at adjacent flight levels all opting for 2 nm right offsets is clearly not optimal use of the procedure, even though it may increase the overall … usage statistics."

Some airlines have instructed their pilots to always select the same offset option, although the concept emphasizes random choices of 1 nm or 2 nm offsets or remaining on the airway centerline, the document said, adding, "The safety benefit could actually be negated if all airlines were to take this approach."

'Equal distribution of the fleet across the centerline and two offsets remains the goal.'

Dixon said that some proposals have suggested that the offsets be assigned by air traffic controllers according to an aircraft's flight level, but authorities typically reject these ideas. He added, "The aim of these suggestions is really to get to the point where offsets are being used to optimal effect" — that is, about one-third of aircraft are using each offset option for tracks that are mainly same-direction.

To the Left

Data on use of offset procedures have revealed what Seal characterized as a "troubling trend" involving cases of the unauthorized use of offsets to the left of centerline.

"This, of course, is not permitted … and significantly increases collision risk," Seal said, adding that — if some aircraft not equipped with ADS also are using left offsets — "hundreds of flights could be flying this incorrect and dangerous offset.

"When [pilots were] queried as to why, responses ran the gamut from 'wake turbulence' to 'why can't I do that?'" he added.

Dixon said U.K. NATS has been working with airline representatives to understand the circumstances in which pilots chose the unauthorized left offsets. The proportion of flights involved is less than 0.2 percent, he said.

In some cases, he said, the pilots admitted that they "did not apply contingency or wake avoidance procedures correctly, which the operators have then been able to provide guidance on. … For the North Atlantic, which is mainly same-direction traffic, left offsets substantially increase the potential for collision, which is why we continue to engage proactively with relevant operators."

Nav Canada's Lachance said that although the "very small percent of flights" that have used an offset to the left have not had an adverse effect on safety, "it is an indication that all aspects of the [strategic lateral offset] procedure may not be properly understood. … Equal distribution of the fleet across the centerline and two offsets remains the goal."

Notes

1. Approximately 45 percent of total traffic in North Atlantic airspace is equipped with ADS–C. Data for evaluating the use of strategic lateral offset procedures are collected at 30 degrees west longitude, which is considered the North Atlantic midway point.
2. U.K. NATS was formerly known as National Air Traffic Services.
3. ICAO. *Procedures for Air Navigation Services — Air Traffic Management*, Document 4444, Chapter 16 "Miscellaneous Procedures," 16.5 "Strategic Lateral Offset Procedures (SLOP) in Oceanic and Remote Continental Airspace."
4. Bolton, Karen. "Don't Let SLOP Slip Your Mind." The document was written as a communication to U.K. operators and later contributed to Skybrary. <www.skybrary.aero/bookshelf/books/1067.pdf>.

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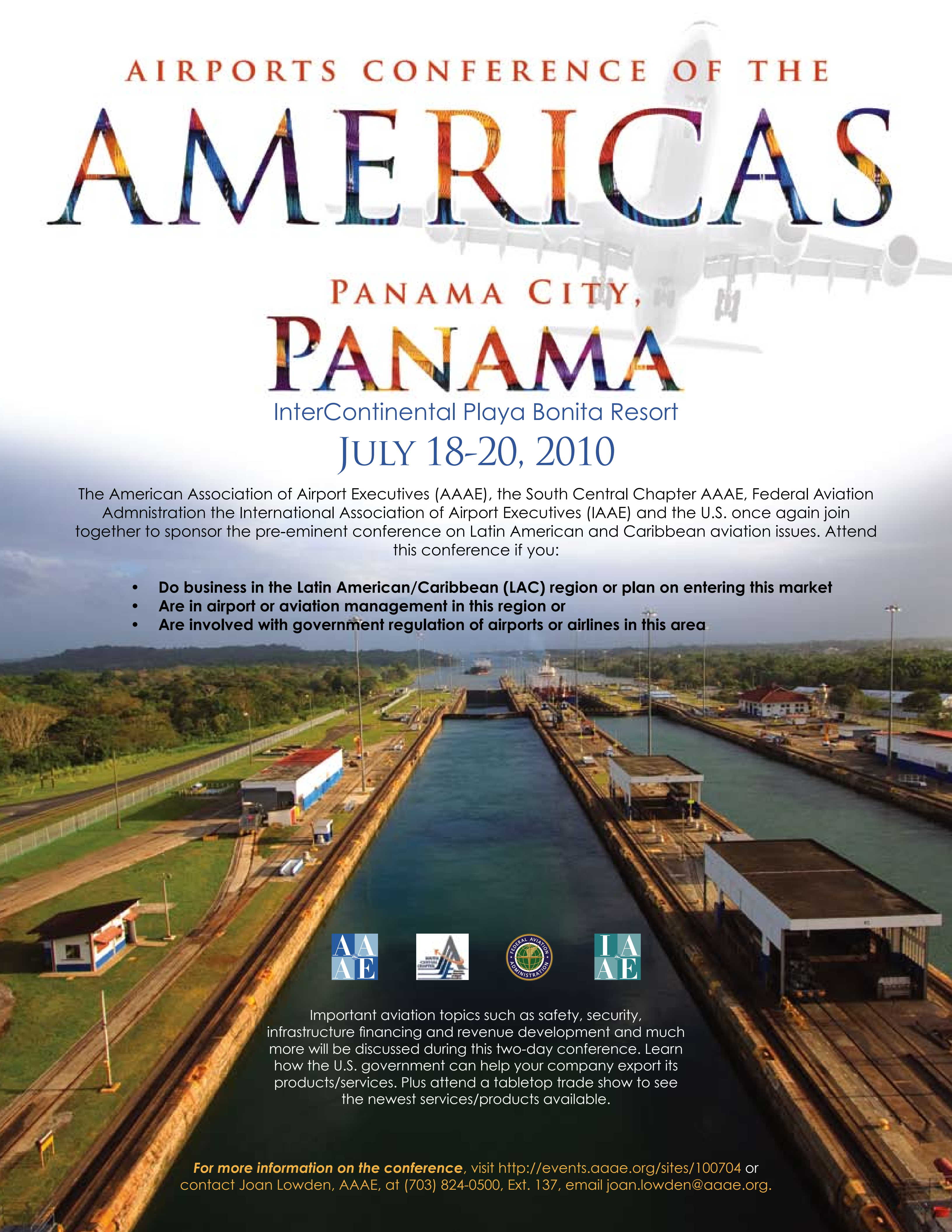
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Foundation explores effectiveness of head-up guidance system technology in accident prevention.

More than a third of nearly 1,000 recent transport category airplane accidents might have been prevented by head-up guidance system technology (HGST), according to a special report released in November 2009 by Flight Safety Foundation (FSF).[1] Moreover, the accident-prevention potential of HGST — largely due to the flight path and airspeed control guidance it provides — is significantly higher in occurrences in which the flight crew is directly involved, such as in takeoff and landing accidents, and loss-of-control accidents, the report said.

The report is based on a study conducted by Foundation Fellows Robert Vandel, retired FSF executive vice president, and Earl F. Weener, retired Boeing Commercial Airplanes chief engineer and now a presidential nominee as a member of the U.S. National Transportation Safety Board (NTSB).

The study was a follow-up to an initial study conducted by the Foundation in 1990. That study focused on civil jet transport accidents that occurred between 1959 and 1989, and concluded that HGST likely could have prevented 31 percent of them.[2]

At the time, HGST — wide-field-of-view head-up guidance systems (HGSs), also called head-up displays (HUDs), that are designed to present critical flight information to pilots during all phases of flight — was just beginning to be assimilated in civil aviation. Since the 1990 study was conducted, the civil aviation fleet has changed significantly, HGST has evolved with major technological advances, and the installation of HUDs in airline and corporate airplanes has increased considerably.

"First- and second-generation large commercial jet transports have generally been replaced by airplanes with glass cockpits and avionics systems based on digital technology," the 2009 report said. "Corporate airplanes have also undergone the change to digital avionics and electronic flight displays."

Discussing the report at the FSF Corporate Aviation Safety Seminar in Tucson, Arizona, U.S., in May, Vandel noted that the Foundation was asked by industry to take another look at HGST to determine if the levels of accident-prevention potential found in 1990 are still valid.

Expanding the Focus

Data for the 2009 study were derived mainly from the Airclaims/Ascend

Safety at EYE LEVEL

BY MARK LACAGNINA

World Aircraft Accident Summary database, the FSF Approach and Landing Accident Reduction database and the FSF Runway Safety Initiative database. The data were supplemented with information from other sources, including NTSB and other national aviation accident investigation agencies.

Expanding the focus beyond the large jet transport accidents examined 20 years ago, Vandel and Weener combed through data on nearly 10,000 accidents and selected 983 accidents from 1995 through 2007 that involved multiengine turbine and turboprop airplanes with maximum gross takeoff weights of 12,500 lb/5,700 kg or more. The airplanes included Western-built and Eastern-built models that, with few exceptions, have entered service since 1980. Excluded from the study were accidents involving military and special-use airplanes, and ground accidents involving civil airplanes.

Each of the 983 accidents was analyzed to determine whether it might have been prevented by HGST, and an independent audit of one in 10 of the accidents was conducted to confirm the analysis standards. "The goal was to gather enough relevant information about each accident to ensure the HGST assessment was as accurate as possible," the report said. The hypothetical scenario used for the assessment assumed a modern, operational HGS installed at the pilot flying's station and thorough training of the pilot flying and pilot monitoring on how to use the HGS.

The report said that the analysis of each accident resulted in one of the following five determinations:

- "Yes — It is *highly likely* that HGST might have prevented the accident;
- "Yes (?) — It is *likely* that HGST might have prevented the accident;
- "No (?) — It is *unlikely* that HGST might have prevented the accident, but information is inadequate to determine [this] with further certainty;
- "No — It is *highly unlikely* that HGST might have prevented the accident; [or,]
- "*Unknown* — Insufficient information is available to reach a reasonable conclusion about the influence that HGST might have had in the accident."

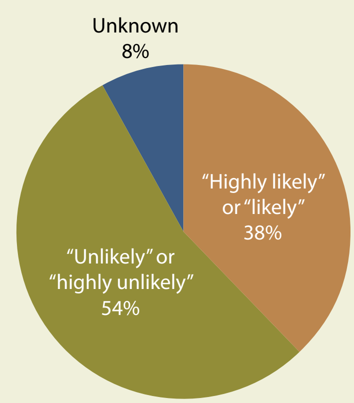
The analyses resulted in determinations that it is highly likely or likely that HGST might have prevented 38 percent (374) of the 983 accidents that occurred during the 13-year period (Figure 1). "Some 54 percent [530 of the accidents] would not have been influenced by the technology, and 8 percent [79 accidents] did not have adequate data to make an assessment," the report said.

Breakdown by Category

To refine the HGST accident-prevention assessment, the 983 accidents were grouped into nine separate categories based on the phase of flight or the primary causal factors. The assigned categories were: "takeoff and landing," "loss of control," "miscellaneous," "propulsion," "undercarriage," "environment," "collision," "explosion and fire," and "mechanical failure."

The results of the analyses of accidents in the categories in which HGST was found to have the greatest potential effect are shown in Table 1 (p. 40). "Of those accidents where the pilot was directly involved, such as takeoff and landing [accidents] and loss-of-control accidents, the likelihood of accident prevention due to HGST safety

Potential Accident-Prevention Effectiveness of HGST



983 Transport Category Airplane Accidents, 1995–2007

HGST = head-up guidance system technology

Source: Flight Safety Foundation

Figure 1

Top Three Accident Categories

Accident Category	Number of Accidents	Accidents Likely Prevented by HGST
Takeoff and landing	341	237 (69%)
Loss of control	123	70 (57%)
Miscellaneous	110	37 (33%)

HGST = head-up guidance system technology

Source: Flight Safety Foundation

Table 1

properties becomes much greater," the report said. Nearly one-half of the 983 accidents were in the takeoff-and-landing, and loss-of-control categories.

Landing accidents far outnumbered takeoff accidents, accounting for 80 percent of the total in this category. The study showed that HGST might have prevented 237, or more than two-thirds, of the 341 accidents in the takeoff-and-landing category. "In only a quarter of the accidents was HGST unlikely to have positively influenced the outcome," the report said.

The report said that HGST might have prevented 70, or more than half, of the 123 accidents involving loss of control.

Of the 983 accidents studied, 110 were categorized as "miscellaneous" because they did not precisely fit any of the other, distinct categories. For example, one accident in the miscellaneous category involved a flight crew that manually depressurized the aircraft after a windshield cracked during cruise flight. Despite donning their oxygen masks, they temporarily lost consciousness. The airplane went into a steep dive, and aerodynamic overload caused portions of the horizontal stabilizer and elevators to separate from the airplane. After regaining consciousness at a lower altitude, the crew recovered from the dive, diverted the flight and landed the airplane without further incident.

The study determined that 37, or one-third, of the 110 accidents in the miscellaneous category likely would have been prevented by HGST.

The "propulsion" category comprised 48 accidents involving engine failures or malfunctions. The study determined that HGST might have prevented or positively influenced the outcome of nine, or 19 percent, of them.

"Accidents resulting from problems with the undercarriage comprised a relatively large set of accidents, although the portion that would [likely have been positively] affected by HGST safety properties is relatively small," the report said. The conclusion was that only five, or 2 percent, of the 207 accidents in the undercarriage category might have been prevented by HGST.

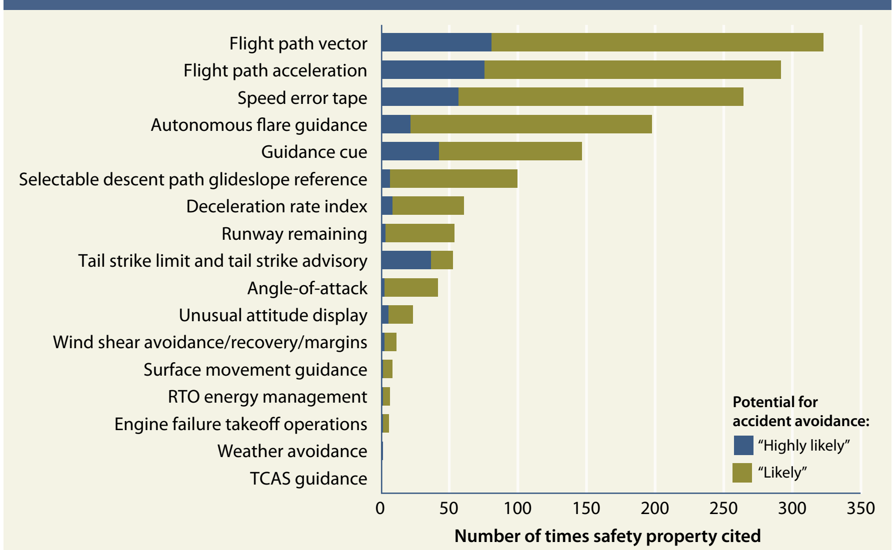
The potential influence of HGST in preventing accidents in the remaining categories — environment (50 accidents), collision (19 accidents), explosion and fire (19 accidents) and mechanical failure (17 accidents) — was found to be low. "In aggregate, these four categories comprised [about] 10 percent of the accidents in the study database," the report said. "In general, these accidents were caused by events or situations out of the pilot's direct control, and it is unlikely they might have been influenced by HGST."

Safety Properties Examined

Drilling further down into the data, the study analyzed the potential accident-prevention effectiveness of 17 individual HGST safety properties — that is, HGS/HUD display features and modes (Figure 2).

The safety properties judged to have the highest potential for preventing takeoff and landing accidents were the flight path vector, flight path acceleration cue, speed error tape and autonomous flare guidance.

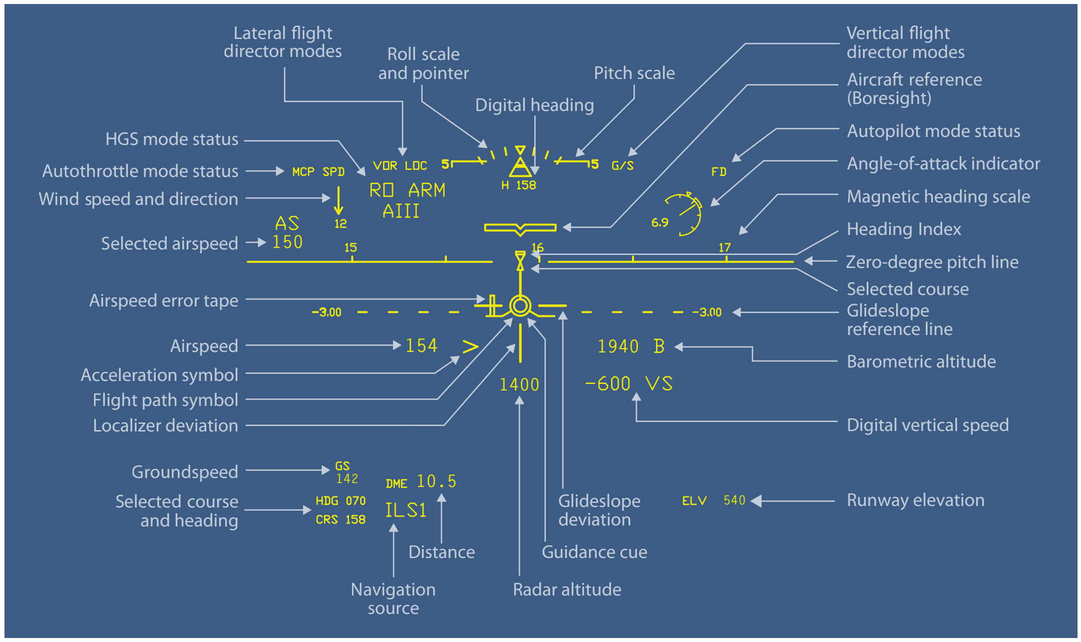
HGST Safety Properties



HGST = head-up guidance system technology; RTO = rejected takeoff;
TCAS = traffic-alert and collision avoidance system

Source: Flight Safety Foundation

Figure 2



This is typical of the information that can be provided — at eye level — on the see-through HGS 'combiner' during approach.

The *flight path vector* "provides instantaneous indication of where the aircraft is going," the report said. The *flight path acceleration cue* indicates the acceleration or deceleration of the aircraft along the flight path. The *speed error tape* indicates deviation from the selected airspeed.

Autonomous flare guidance, which is presented when the airplane is about 100 ft above ground level, "would have positively influenced almost half of the accidents in this category," the report said.

Another safety property, the *selectable descent path glideslope reference*, also was found to be a potentially important tool in preventing landing accidents. Based on the glide path value selected by the flight crew, this feature guides the crew in initiating and flying a constant-descent-angle approach. "In many of the accidents, a precision approach was not flown," the report said. "In those cases, the selected descent path glideslope symbology [would have] presented the means to increase the precision of a nonprecision approach."

The flight path vector, flight path acceleration cue and speed error tape also were judged to have the greatest potential among safety properties for preventing loss-of-control accidents. Because the incidence of tail strikes was relatively high in this category, the *tail strike limit* and *tail strike advisory* feature also was deemed an effective tool. The tail strike limit symbol appears on takeoff if the airplane is being rotated at a rate or to an extent that a tail strike could occur. On landing, the tail strike advisory appears if the airplane is in an attitude or is being flared at a rate that could cause a tail strike.

"In many cases, the unusual attitude symbology would have come into play, as well," the report said. The *unusual attitude display* appears automatically to aid in recognition of, and recovery from, an unusual attitude. The display consists primarily of a large attitude indicator with distinct sky and ground indications, and with the basic airspeed and altitude scales; extraneous information is temporarily deleted to "declutter" the HGS/HUD, allowing the pilot flying to focus on the guidance for recovering from the unusual attitude.

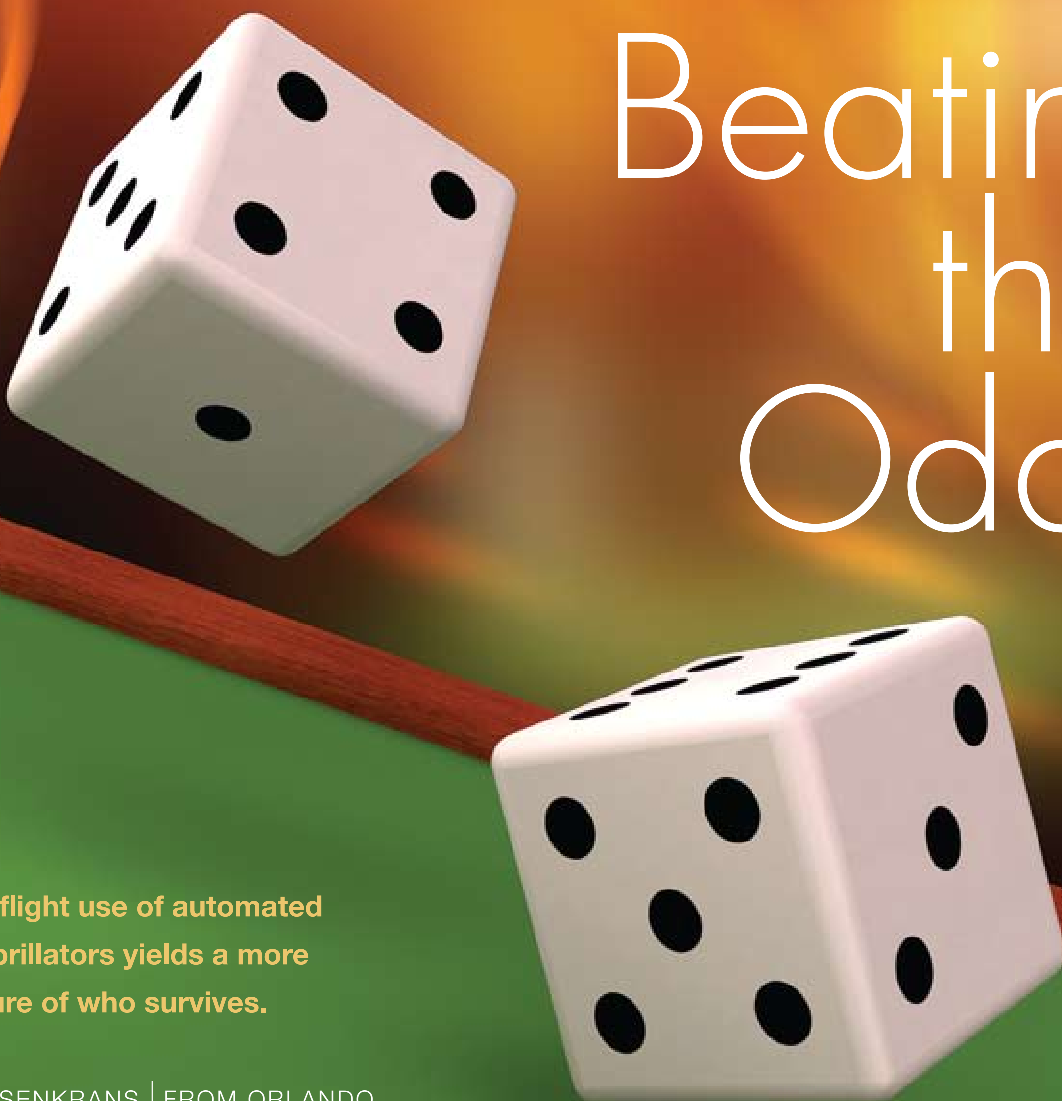
The report concluded that "the HGST safety properties were found to be most effective in those areas where the pilot was directly involved," such as the situations leading to the takeoff and landing accidents, and loss-of-control accidents, and many others that were categorized as miscellaneous. "Focusing on these three areas specifically, HGST [might have prevented] 59 percent of the accidents in the combination of these three categories," the report said.

Notes

1. FSF. *Special Report: Head-Up Guidance System Technology — A Clear Path to Increasing Flight Safety*. November 2009. The full report is available at <flightsafety.org/archives-and-resources/special-reports>.

2. The results of the 1990 study were published in "Head-up Guidance System Technology (HGST) — A Powerful Tool for Accident Prevention." *Flight Safety Digest* Volume 10 (September 1991).

Beating the Odds



Review of in-flight use of automated external defibrillators yields a more realistic picture of who survives.

BY WAYNE ROSENKRANS | FROM ORLANDO

An airline passenger's sudden cardiac arrest during flight creates a rare and stressful experience for the responding flight attendants, and health outcomes of these events have been significantly poorer than in gambling casinos although automated external defibrillators (AEDs) are widely used in both environments. Yet feedback to crews about in-flight "saves" and deaths involving AEDs has been scarce, says Paulo Alves, a cardiologist and vice president, aviation and maritime health, MedAire. He was among the presenters at the 27th International Aircraft Cabin Safety Symposium in Orlando, Florida, U.S., held April 27–29. His presentation, like others highlighted in this article, emphasized practical applications of newly available data sources.

MedAire's data — representing 947 cases of in-flight use of an AED among airlines receiving assistance from the MedLink Global Response Center — showed that when the AED was used to analyze electrical activity in the victim's heart after signs of sudden cardiac arrest, and the synthetic voice said "shock advised," about one-fourth survived long enough to obtain hospital care (Figure 1). Before AEDs, this mortality rate would have been 100 percent; nevertheless, the rate of saves documented in casinos has been up to about 70 percent for those shocked by an AED within three minutes of collapse, he said.

"In comparison with the passenger traffic, very few people die in flight," Alves said. "The reality is that the industry has 0.05 deaths per billion revenue passenger kilometers … one death for every 7 million passengers carried. MedLink deals with 4.8 in-flight deaths every month."

Sudden cardiac arrest was one of several natural causes of these deaths; it has been the most common way an otherwise healthy person dies outside a hospital. Ventricular fibrillation — an arrhythmia in which the heart quivers rapidly — occurs in 70 percent of these

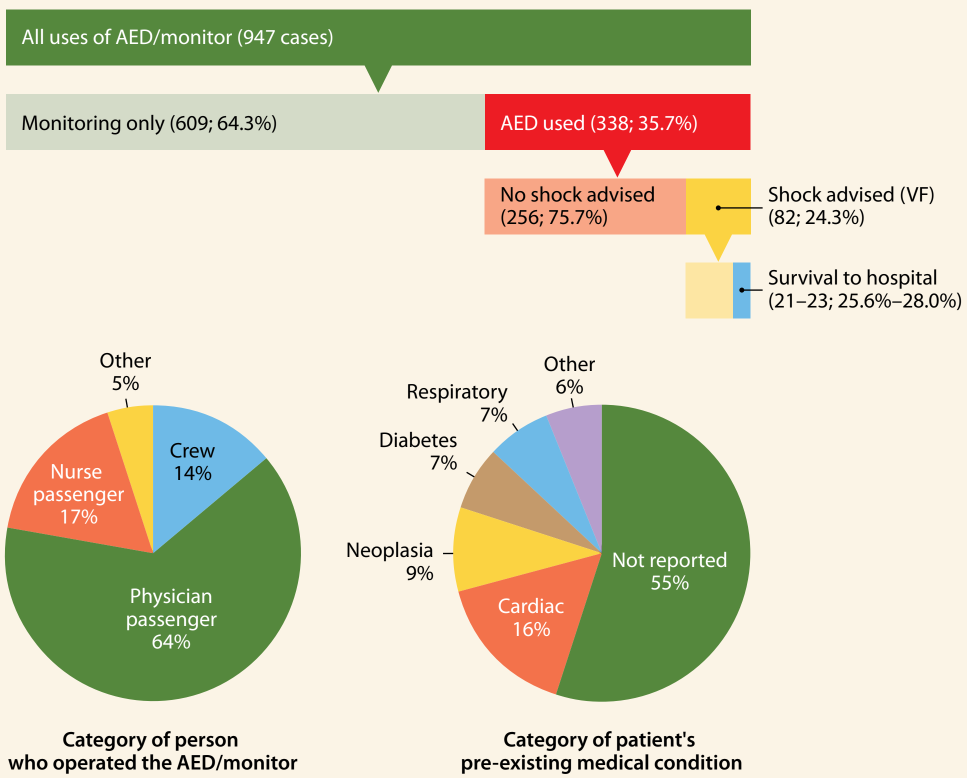
cases, Alves noted. The AED's shock is intended to stop the ventricular fibrillation, enabling the body to "reset" a normal heartbeat.

MedAire data reflect that although ventricular fibrillation most often was documented during the earliest parts of a flight, it also may have involved unwitnessed collapse in the middle of a long-haul flight — that is, the passenger's loss of consciousness was not observed within three minutes by other passengers or cabin crew. "Sometimes they were sleeping, so others did not identify the collapse," he said. "Many people who started feeling ill went to the aircraft lavatory and collapsed there. It was also difficult to notice whether a person was breathing or not, especially under low-light conditions." The primary distinction from casinos, Alves concluded, apparently was the constant surveillance of casino customers by security systems and officers.

AEDs automatically record the sequence and timing of the first responder's actions to enable medical review. Alves found examples of in-flight rescuers performing cardiopulmonary resuscitation (CPR) with only five to 47 chest compressions per minute, most often five, and excessively long pauses between sets of 13 compressions to give two ventilation breaths. This was contrary to the 2005 guidance recommending more than 100 compressions per minute.

"Carrying AEDs has been a historic move for the aviation industry ... something fantastic ... and flight attendants saving lives in about 24 percent of cases has been remarkable given the remoteness of hospital care," Alves said. "But

In-Flight AED/Monitor Utilization, January 2001–December 2008



AED = automated external defibrillator; VF = ventricular fibrillation

Note: These in-flight medical events occurred among airlines receiving assistance from the MedLink Global Response Center. "Survival to hospital" numbers represent the range of data accuracy.

Source: MedAire

Figure 1



Top to bottom: Alves, Nesthus and Karlsson

Photos: Wayne Rosenkrans

there are chances for improvement. We recommend a high level of awareness in the cabin to identify victims as early as possible to deliver a saving shock."

Broadening CRM

Aviation safety action programs (ASAPs) in the United States — voluntary, nonpunitive safety reporting programs — increasingly provide insights into broader applications of crew resource management (CRM), said Sandra Ingram, manager, onboard service–safety and security, United Airlines, and Vicki Jurgens, chairperson, Safety, Health and Security Committee, Association of Flight Attendants–Communications Workers of America, and a United Airlines purser.

"CRM developed [originally] as an open-door concept," Jurgens said. "We no longer have an open door … and we are not sure that current CRM training goes far enough … not only in the way that we handle passengers but in how we handle ourselves." A common language, safety culture and synchronization of information must be integrated across all airline systems, Ingram added, and ASAP event review committees should not hesitate to delve deeply into flight attendant ASAP reports that may seem insignificant by their numbers alone.

"We have started seeing reports of incidents involving flow of information that are making us uncomfortable, one [incident] resulted in a diversion," Jurgens said. "If the communication is flawed, we put ourselves at risk. … So we have to make sure that our CRM training not only touches our crew but everyone who works with our crew." Rifts between flight attendants and gate agents may result in one group or the other abdicating responsibility for decisions or actions that affect safety, for example, she said.

"We employ a risk ranking because we know that [the issue in] any one of the ASAP reports has the potential for great damage," Ingram noted. "We have had minor incidents, just a personality conflict, all the way up to diversions of aircraft and other significant events. If some of the flight attendants and pilots had used their CRM skills, perhaps the diversions could have been averted. So we put ASAP reports under the microscope to determine what was happening, what was causing degradation of crew camaraderie and effective outcomes."

Communication Breakdowns

A paper on the causes and effects of recent communication breakdowns between flight crews and cabin crews will be published in mid-2010 in the FAA *International Journal of Applied Aviation Studies,* said Lori Brown, the paper's author and a faculty specialist in the College of Aviation, Western Michigan University, U.S. "The industry actually has added communication barriers," Brown said. "The only barrier reported to have been improved over the past 14 years was aircraft systems familiarization for cabin crew. Survey respondents' main concern was obtaining an adequate preflight briefing. Many said briefings are only given to the purser/lead flight attendant."

One respondent wrote, "Having just completed my annual CRM [training], I was reminded just how little the flight attendants know about what's happening up in the front. There needs to be a fundamental shift in thinking … to rebuild the relationship." Another said, "It is not uncommon, when working in the back, to have never met the flight deck crew when we fly just one segment. That is dangerous."

Of 224 flight attendants surveyed, 55 percent reported that they have been hesitant to report a problem and 16 percent indicated that they had experienced a situation in which they did not report a problem to the flight deck because they assumed the pilots would already know about the problem, Brown said. "Of 51 pilots surveyed, 41 percent indicated they had situations where a flight attendant did not report a problem."

Midway Overrun Lessons

Evacuation lessons from the December 2005 accident in which a Boeing 737-700 overran Runway 31C at Chicago Midway Airport (*ASW,* 2/08, p. 28) were summarized by Larry Parrigin, manager, in-flight services curriculum and program development, Southwest Airlines. The Midway evacuation took an estimated five to 10 minutes. The collapsed nose landing gear caused the aircraft to come to a stop in a nose-down, tail-high attitude with forward doors close to the ground. Slides at the L1 door, overwing exits and aft doors were deployed, and aircraft rescue and firefighting (ARFF) personnel positioned stairs at the aft galley service door, Parrigin said.

"These passengers couldn't understand what flight attendants using megaphones were saying, so the forward flight attendant started going back into the cabin, repeating announcements about once every four rows," he said. "The flight attendants did exactly as they were trained, but we found that they were not holding the megaphones close enough to their mouths for the microphones to pick up what they were saying." Every Southwest flight attendant now practices retrieving megaphones from brackets and loudly issuing intelligible commands during both initial training and annual recurrent training, he said.

The accident airplane flight attendants had been trained to wait for the captain's evacuation command if the cabin was intact and there was no apparent threat such as interior damage, water, smoke, fumes or fire. Revised training emphasizes that an unusual aircraft attitude, in combination with other threats, is a valid evacuation trigger after flight attendants attempt to contact the flight crew.

In the minutes prior to this evacuation, one flight attendant left the assigned aft exit armed and unmanned to seek information about what to do. A much safer action would have been to enlist a passenger to relay information to and from other flight attendants, and to report and observe what was happening outside the aircraft, Parrigin said.

Revised training has flight attendants practice adapting memorized procedures and commands to fit the circumstances. "In this evacuation, the forward slides had inflated parallel to the ground onto a landscaping berm," he noted. "The flight attendants at these doors had said, 'Come this way, leave everything, cross your arms and jump' onto these slides." Passengers could not slide down, however; they had to maneuver themselves along the slide or be lifted off the side of the slide by firefighters on the ground.

FAA Fatigue Research

The final step in a flight attendant fatigue research project, directed in 2005 by the U.S. Congress, should be completed in 2010 and lead to "a look into potential regulatory revisions," said Thomas Nesthus, a research psychologist in the Aerospace Human Factors Research Division, FAA Civil Aerospace Medical Institute (CAMI). This quantitative study of 210 flight attendants on duty and off duty has been examining "physiological and neuropsychological effects, fatigue, sleepiness, circadian rhythms and rest schedules," he said.

"This field study is our most complex yet … and the sole source of objective data," Nesthus added. "[Before] possible revisions of regulations, we want to have … objective data saying that the schedules are problematic and we need to make some changes." As of late April, about 175 flight attendants had completed their data collection. Data have been generated by wrist-worn activity sensors, psychomotor vigilance tasks using mobile phone–based personal digital assistants, pedometers and other monitors of sleep, activity level, fatigue and alertness. Data collection was scheduled to be completed during May.

Free Realistic Training

Struggles to overcome budgetary constraints and provide realistic recurrent-training experiences have been alleviated at a small Swedish airline through partnerships based on bartering for resources, said Anna Mellberg Karlsson, emergency and CRM instructor, Novair. "We have a hard time getting our people to a cabin training mockup of the correct aircraft type," Karlsson said, a situation that sometimes requires explaining Airbus door operational differences while substituting a 737 mockup.

Novair's no-cost partnerships, however, have opened opportunities to experience sea survival and hyperbaric chamber training in cooperation with Swedish military training centers. Company instructors also have enlisted outside specialists, such as ARFF specialists who cover how they will interface with the crew in an evacuation; emergency-care nurses who demonstrate patient triage principles and methods of stabilizing injured people at the scene of an aircraft accident; and airport duty officers.

"All these experiences became possible by instructors showing interest, being very persuasive and exchanging favors," Karlsson said. "For example, we lent an aircraft, a crew and instructors to the national police force for hijacking scenarios."

Novair recently began integrating refresher-training tasks into line operations. "Three months before recurrent training, pilots and flight attendants received a document with five tasks to perform when time permits, requiring their cooperation [and mutual sign-offs] during the flight," Karlsson said. "One task example was flight attendants entering the flight deck and operating a pilot seat to perform the pilot-incapacitation drill."

J.A. DONOGHUE | PANAMA CITY, FLORIDA, U.S.

To Build an Airport

Starting with a clean sheet of paper, how would you design an airport?

Building a completely new airport in the United States is not an easy thing to do, especially if that airport has a 10,000-ft (3,048-m) runway, a 5,000-to-6,000 ft (1,524-to-1,829 m) crosswind runway in the works and land reserved for an 8,400-ft (2,560-m) parallel runway. After detailing excellent reasons for building an airport, land and financing must be found, approvals must be obtained from local, regional, national and environmental authorities, and economic justifications must be locked in. Given all of this, it is not surprising that it wasn't until late May that the first new U.S. air carrier airport of the 21st century — the Northwest Florida Beaches International Airport (KEPC) — opened.

And what timing: Citizens of the region centered around Panama City, justifiably proud of the area's pristine white beaches, found themselves on the day the airport opened staring out into the Gulf of Mexico, watching for signs of oil drifting from the damaged well several hundred miles to the southwest. The oil may not land on this beautiful crescent of beaches, but the looming threat certainly didn't enhance the opening celebrations.

It would be wrong to say that the old Panama City Airport (KPFN) couldn't draw flies; there were several fixed base operators (FBOs) there and Delta Air Lines had a few services daily, most regional jets to Atlanta, and annual traffic was more than 300,000 people. But a major service improvement of the airport to attract larger aircraft, with the main runway of 6,308 ft (1,923 m), would have required a physical expansion, made difficult by housing on all sides of the airport not bounded by a bay and wetlands.

Community leaders saw an overwhelming need for a larger, 24-hour airport with greater utility and drawing power. The beaches are one traffic lure, but so, too, are the increasing number of high-tech defense-focused industries opening up facilities in the region to take advantage of a cluster of U.S. military bases charged with developing new systems and technologies.

A third essential ingredient in the KECP development stew is the involvement of the St. Joe Company, a firm with massive land holdings originally purchased for pennies on the acre for pine forests to feed its lumber and paper business. Some years ago the firm decided that a better business would be the development of its land so close to the water for housing and industry. Sensing that an airport could be the engine for a new level of development, St. Joe donated a 4,000-acre parcel for the airport and associated facilities; that includes fixed base operators — Sheltair Aviation Services is moving from KPFN — cargo facilities and a 125,000-sq-ft (11,612-sq-m) terminal capable of handling widebodies at some of its seven gates.

The result is an airport that is buffered from local communities by acres of pine forests, yet is a fairly short drive to the region's tourism, population and industry centers.

Taking in the vista with the eye of a "normal" person from the tall air traffic control tower, there isn't much to see, and that is exactly the appeal to pilots and operators. Miles and miles of flat

Photos: J.A. Donoghue

land, with approaches to Runway 16 or Runway 34 unobstructed as far as the eye can see in the bright, hazy Florida light.

While built with a standard runway end safety area (RESA), there really wasn't much to build aside from bulldozing and clearing acres of pine — with St. Joe involved, "harvesting" is probably a better term —and, *voilà*!, a wonderful RESA with a sandy soil base.

One of the airport's key rationales is improving the flow of tourists to a region that, until now, has been a well-kept secret to anyone living north of Atlanta. While Delta is transferring its largely Atlanta-hubbed service to the new airport, local community promoters sought a wider fetch, and so lured Southwest Airlines into a first-of-its-kind deal for the low-cost carrier that results in twice-a-day service from markets with a major Southwest presence —Baltimore/Washington, Orlando, Houston Hobby and Nashville airports. In exchange, the local authority will cover any Southwest losses on the service over a three-year period.

U.S. domestic operators don't need such a long runway that can, in fact, be easily stretched to 12,000 ft (3,658 m). International operations are the eventual goal for the new airport, developers readily admit.

However, the suite of initial airport equipment is not lavish. There is a single Category I instrument landing system/distance measuring equipment approach for Runway 16, with the lights and supporting systems required by regulation, but not much beyond that. There also are published global positioning system nonprecision approaches to both runways.

While weather in the region is generally benign, perhaps regular transatlantic operations might be more attracted to the airport by a higher level of system support to better assure regularity of operations.

It does, however, rain in Northwest Florida, often a lot over a short time. Asked about ponding water on the runway, a construction manager bristled, his irritation an artifact of past battles waged with environmentalists concerned about both the alteration of wetlands and the handling of runoff. The runway, he said, drains well and is grooved.

The air traffic control tower for the Class D airspace at KECP is a Level 1 contract facility using visual ground control guidance. The aircraft rescue and firefighting service is handled by an ARFF Index B facility.

The nearby military bases surround KECP with military operations areas, and approach and departure control is handled by Tyndall Air Force Base.

Care was taken in laying out the airport to minimize the chance of runway incursions. The future crosswind runway, aligned 05/23 on the south end of the main runway, will be close to the FBO and general aviation ramp. The cargo facility is directly south of the tower, with the passenger terminal on the north side of the tower. If the parallel runway is built, it will be on the other side of the entrance roadway, so no runway crossing will be required to reach any of the runways.

One of the high-tech industries that fits well with local needs and workforce population is aircraft maintenance, repair and overhaul, and considerations have been given for building on the airport to support such activity. Cargo also is getting a lot of attention, with an effort being made to maximize KECP's multi-modal potential.

Airport backers, having invested $318 million in the project, now have their fingers crossed that traffic will come and the oil will stay away.

BY RICK DARBY

Bin There, Done That

A survey of flight attendants reveals safety concerns about passenger carry-on baggage.

Carry-on items falling from overhead storage bins struck about a third of responding flight attendants at least once during a one-year period. This was among the findings of a membership survey by the Association of Flight Attendants–Communications Workers of America (AFA-CWA). Most of the encounters resulted in relatively minor injuries in the "bruise" and "bump" categories, but "sprain," "cut," "puncture" and "abrasion" also were noted, as was one incident of "concussion."

In comments collected in a qualitative part of the survey and supplied to *AeroSafety World*, some of these flight attendants said that the airline charges for checked baggage instituted in recent years had motivated passengers to bring more, and heavier, carry-ons into the cabin than were formerly allowed.

"It has gotten out of control," said one flight attendant. "I believe that the airline's policy of charging for the first checked bag has contributed to this increase. Although the *quantity* of bags passengers bring aboard is being monitored much more closely, the *size* and *weight* are not. Also, passengers are combining bags into a larger carry-on and then holding up boarding by 'disassembling' the carry-ons into separate pieces once aboard in order to stow them."

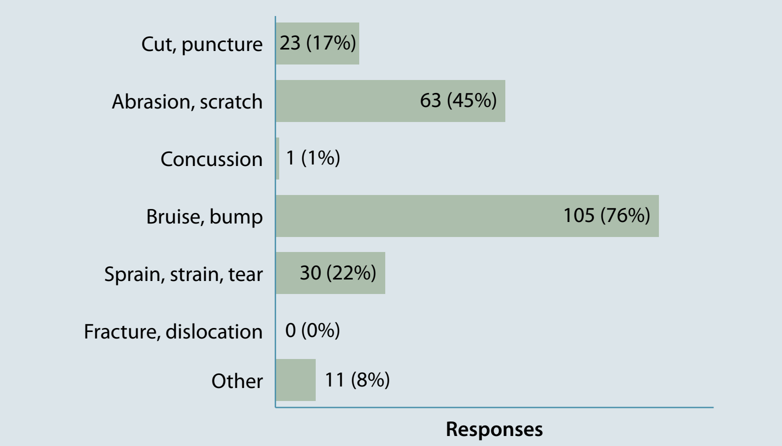
The survey was conducted via e-mail using a sample of AFA-CWA members. From an original list of 25,359 members, 20 percent from each airline were selected randomly. In all, 1,283 completed surveys were obtained and analyzed, a 25 percent response rate.

Among the reported injuries to flight attendants caused by falling carry-on items, 76 percent were categorized as "bruise, bump" (Figure 1). At 45 percent, the combined "abrasion, scratch" category was in second place.

Anatomical sites of those injuries varied considerably (Figure 2, p. 50). The combination category "arms, elbows, forearms, hands, fingers" accounted for 71 percent of those injured. Only "organs other than the brain," among the listed response choices, escaped entirely.

Types of Injuries From Falling Carry-On Items

What types of injuries did you experience during the past 12 months from being struck by passenger carry-on items falling out of overhead bins?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

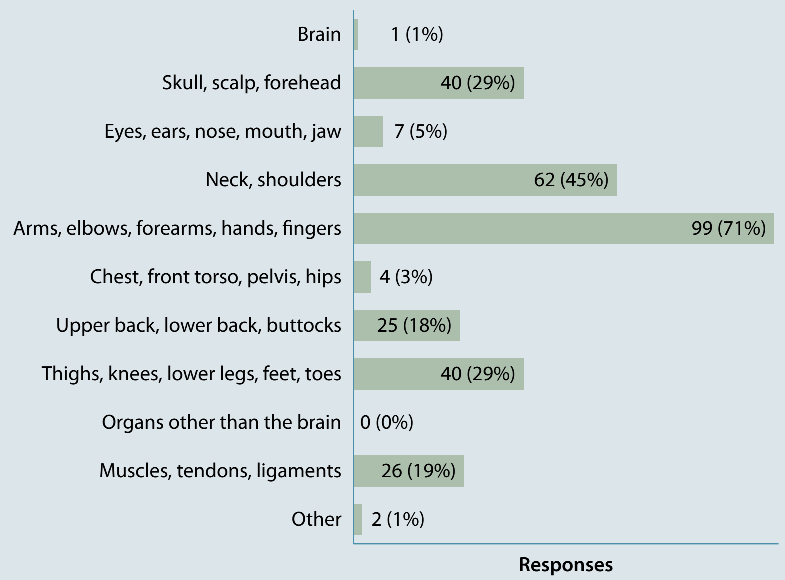
Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 1

Anatomical Sites of Injuries From Falling Carry-On Items

What parts of your body were injured during the past 12 months from being struck by passenger carry-on items falling out of overhead bins?



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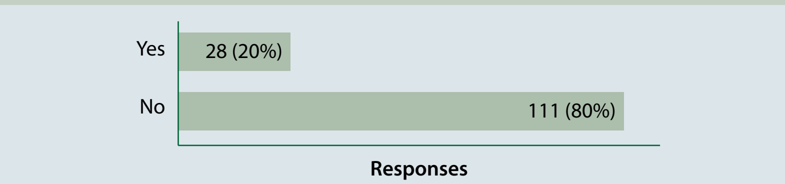
Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 2

Reported Injuries From Carry-On Items

Did you report to your employer any injuries that you sustained during the past 12 months from being struck by passenger carry-on items?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

Source: Association of Flight Attendants–Communications Workers of America

Figure 3

Eighty-two percent of the flight attendants injured by falling carry-ons lost no workdays as a consequence, analysis showed. However, 13 percent were out of work between two and 20 days. Three percent lost more than 20 days of work.

Data showed that 20 percent of those who said they had been hurt by "being struck by passenger carry-on items" reported the event to their employer (Figure 3). In the comments, this lack of reporting was often explained by expressing the belief that it would have been useless or counterproductive.

"Most injuries are minor or the pain does not show up for several hours later," said a respondent. "It is usually too late and/or not worth the time and effort to fill out paperwork, nor the expense of going to the doctor, but you ache at the end of the day."

Another said, "The reason I did not report my injuries from carry-on–related incidents is that I had previously sustained a serious injury to my neck/shoulders, so the injuries/strains/etc. [that] I'm having now seem to be increasing/reinjuring the previous neck injury. I do miss work due to my neck (bulging discs/two pinched nerves) and have missed work since the carry-ons have gotten out of control; however, I did not file [for] worker's compensation for my neck since I knew they'd hassle me over it. I take my own time off."

Other ways are readily available for being injured in connection with overhead bins besides falling contents. They include lifting carry-ons, loading them into the bins, unloading them, and shifting bags around to get them all to fit. Among the 81 percent of respondents reporting injuries from these activities, 58 percent placed them in the "sprain, strain, tear" category (Figure 4). Other commonly reported injury categories were "bruise, bump" and "abrasion, scratch." Although rare, cases of "concussion" and "fracture, dislocation" were said to have occurred.

"Passengers think it is part of the crew's job to lift their bags for them," a flight attendant said. "Bags keep getting larger and heavier, and we can't possibly lift or position multiple bags every day. It is no surprise that many flight attendants have back/shoulder/arm/neck injuries."

Another said, "This is the hot topic of discussion, as it seems flight attendants' focus on safety and security of passengers during boarding has been shifted to handling passenger carry-on items: repositioning, bringing bags to the front of the aircraft and giving the passengers a free-checked-bag opportunity, which encourages them to keep repeating it, instead of checking [the bag] and paying at the ticket counter, thus making a mockery of airline policies."

Respondents who reported injuries from lifting, placing and maneuvering items into overhead bins most often described their injuries as being located in "arms, elbows, forearms, hands, fingers"; "neck, shoulders"; or "upper back, lower back, buttocks" (Figure 5). Other injuries were fairly evenly distributed among other parts of the body.

"While I did not sustain any major injuries, I definitely have been left with lower back pain after assisting with bags," a flight attendant said. "Bumps, bruises and scratches are almost a daily occurrence on the job," said another.

"For us shorter folks it is even more strenuous having to spin, slide, scoot and lift bags into the overhead bins," a flight attendant reported. "The weight of the bags has increased and more people are asking or *telling* us to find a place for a bag and lift it up there for them."

Lifting is only part of the potential injury scenario. Bags of various sizes and configurations often need to be rearranged in the overhead bins to obtain maximum storage use.

"Baggage has taken top priority, because if I don't stay proactive on rearranging bags and placement of bags, we will have a delay and I will be called by a supervisor upon landing and asked to explain the cause of the delay," commented a flight attendant. "I have noticed recent pain in my shoulders, neck and elbow from trying to move and lift large bags in the overhead compartments."

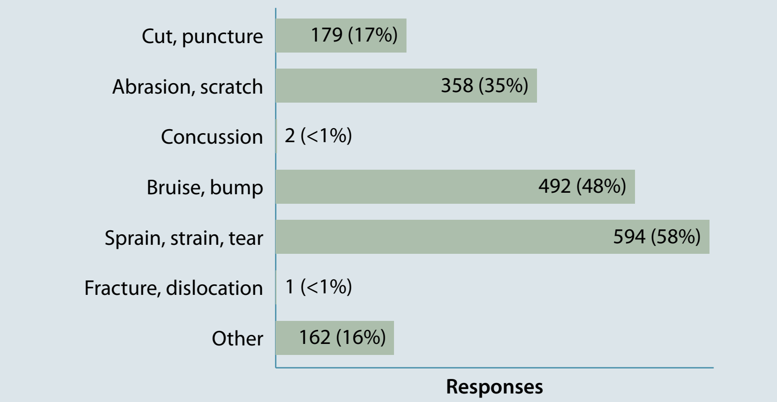
The wear and tear on flight attendants from lifting and arranging carry-on items in the bins usually resulted in no lost workdays (Figure 6, p. 52). For some, however, the time-out was significant. One hundred twenty-six respondents said they had lost from two to 20 workdays, and 24 said that associated physical symptoms cost each of them more than 20 workdays in the one-year study period.

Few saw any reason to report this type of injury to their employer — 8 percent of those who claimed injury did so.

Tripping over passenger items that were in the aisle or protruding from under seats was

Types of Injuries Related to Overhead Bins

What types of injuries did you experience during the past 12 months from opening or closing overhead bins, lifting/placing items into overhead bins, removing items from overhead bins, or re-positioning items in overhead bins?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

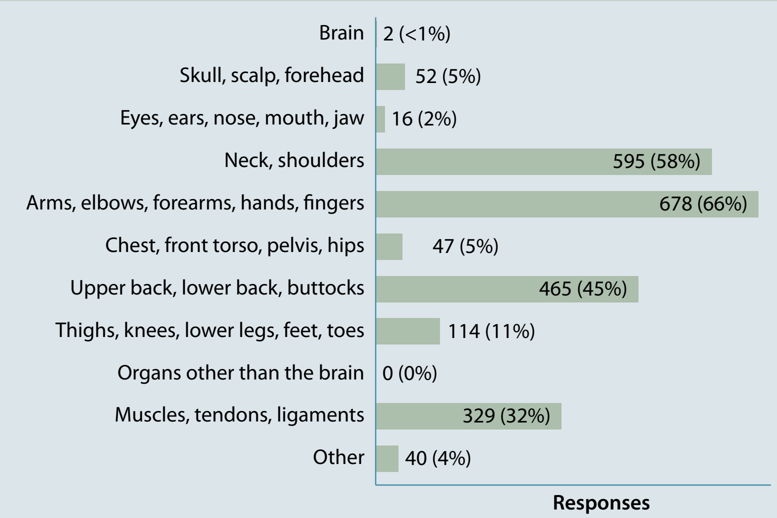
Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 4

Anatomical Sites of Injuries Related to Overhead Bins

What parts of your body were injured during the past 12 months from opening or closing overhead bins, lifting/placing items into overhead bins, removing items from overhead bins, or re-positioning items in overhead bins?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 5

another reported hazard. Injuries from carry-ons impinging on the aisle resulted in injuries to 37 percent of respondents. The threat was judged to be particularly insidious because, as one flight attendant pointed out, those working the service carts were often stepping backward and could not see the objects.

Most injuries from tripping were in the "bruise, bump" category, but as with the other causal factors, there were rare serious injuries that included four cases of "fracture, dislocation"; 31 of "cut, puncture"; and one of "concussion" (Figure 7).

"Passengers do not want to place small items beneath their seats because it impedes their leg room, and if they do place items beneath their seats, they almost always place their limbs in the aisle," a flight attendant said. "I have tripped over many bag straps [and] pieces of luggage that passengers have just left in the aisle because there is no space."

Said another, "It is more than 12 months [since the accident], but one bag out in the aisle caused me to trip in 2005 and I was off work 2.75 years, three hip surgeries and the promise of a new hip due to it. Changed my life in a very bad way. Pain every day."

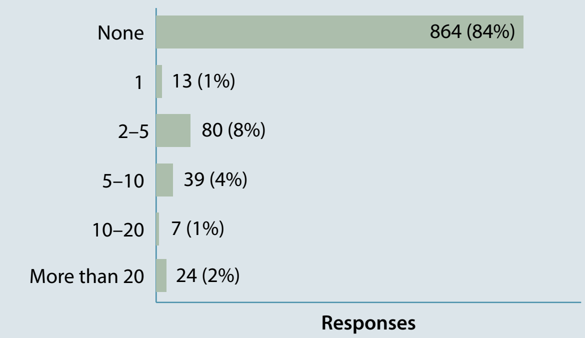
The survey found that carry-on injuries were not related only to the handling of passengers' items in overhead bins or tripping over items protruding from under seats. Twenty-two percent of respondents said that they had been injured as a result of carry-on items that were in the cabin but not in the overhead bin. Of the injured, 66 percent said that they had suffered "sprain, strain, tear" (Figure 8) Next in frequency were "bruise, bump" — reported by 42 percent of the sample — and "abrasion, scratch."

"I have never had so many bruises on my hands [since the difficulty of closing bins has increased]," was among the written comments. "It has added to the advancement of my carpal tunnel [syndrome] and sprained wrists just trying to close the overheads."

The survey also asked about the phases or conditions of flight in which flight attendants

Lost Workdays Related to Overhead Bins

How many days were you away from work as a result of injuries sustained during the past 12 months from opening or closing overhead bins, lifting/placing items into overhead bins, removing items from overhead bins, or re-positioning items in overhead bins?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

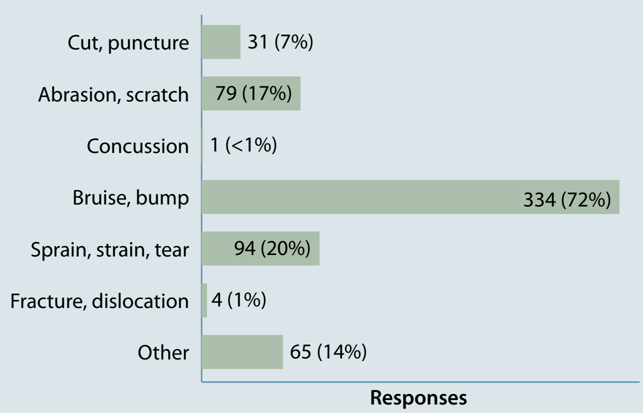
Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 6

Types of Injuries From Tripping Over Carry-On Items

What types of injuries did you experience during the past 12 months as a result of tripping over passenger carry-on items that were in the aisle or protruded from under seats?



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Source: Association of Flight Attendants–Communications Workers of America

Figure 7

had witnessed falling items during the previous 60 days. The study period of 60 days rather than one year was chosen because respondents were expected to have less-clear long-term memories of these events than of personal injuries.

Understandably, items tumbled from overhead bins most commonly prior to takeoff and during exiting following a flight (Figure 9). But 27 percent of respondents reported bin item spillage during the takeoff roll and climb, and 23 percent said that it had occurred during cruise other than turbulence encounters, which was a separate category. In reply to a following question, 30 percent of the flight attendants who observed falling items reported one or more passenger injuries.

"I am greatly concerned that overhead bin weight limits are not being adhered to," a flight attendant said. "I have seen overhead bins pop open upon takeoff, and during an emergency or hard landing, it could be very hazardous."

Although it did not figure prominently in the survey comments, some flight attendants mentioned that carry-ons ejected from bins could hinder an emergency evacuation. Said one: "I would hate to have an emergency where we had to evacuate the airplane, because there is so much luggage on board I think it will slow down the evacuation time."

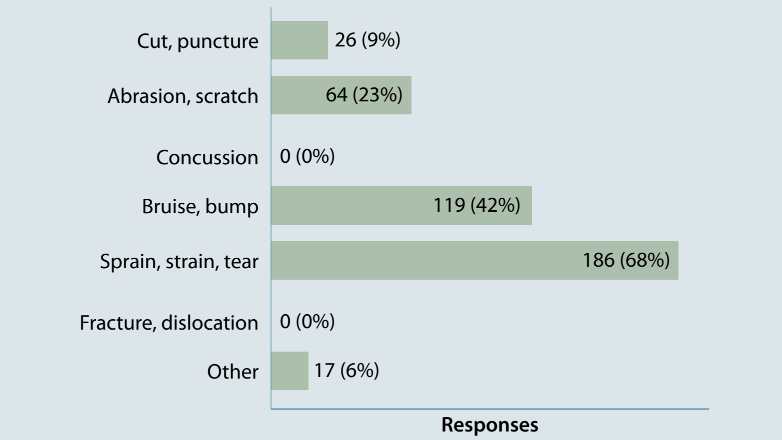
Many flight attendants who responded to the survey offered suggestions for reducing the problem of injuries caused by carry-on items. The most frequent were that:

- Airlines should enforce size and weight limits for carry-ons; and if they fail to do so,
- Uniform carry-on size and weight limits should be applied to all airlines, and a government agency such as the Transportation Security Administration should enforce the rules; and,
- Rather than charge passengers for checked baggage, airlines should allow baggage stowed in the hold to fly free and instead charge for carry-ons, or for carry-ons greater than strict size and weight specifications.

"If passengers were allowed to check bags for free and charged to bring items on board, the baggage problem would solve itself," a survey respondent said.

Types of Injuries From Handling Carry-On Items

What types of injuries did you experience during the past 12 months as a result of handling (i.e., lifting, carrying, stowing, etc.) passenger carry-on items that were in the cabin but *not* in an overhead bin?



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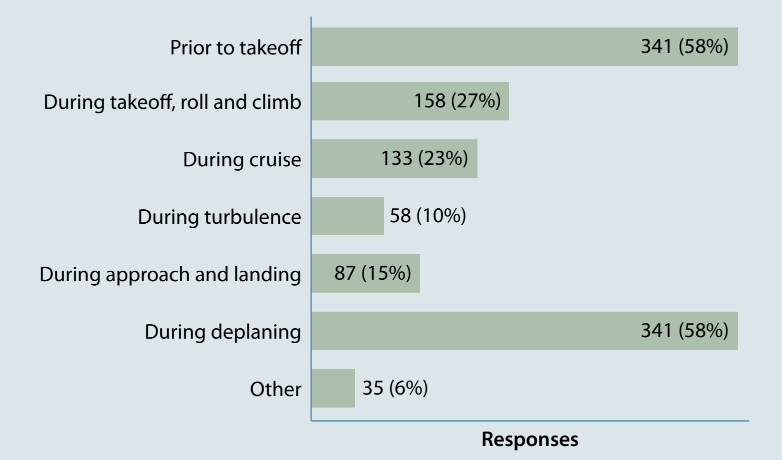
Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 8

Phases of Flight and Flight Condition, Falling Carry-On Items

During the past 60 days, on any flights that you were either working or deadheading, during what phases of flight have item(s) fallen from one or more overhead bins (check all that apply)?



Notes: Data are from a written survey of 1,283 flight attendants on U.S. air carriers.

Percentages are based on the number of respondents who answered "yes" to a question about whether they had experienced any of the types of injury listed. A respondent could report more than one category of injury.

Source: Association of Flight Attendants–Communications Workers of America

Figure 9

Divided by a Common Language

ICAO's English-language proficiency standardization efforts still leave room for improvement.

REPORTS

You Say Overshoot, I Say Go Around

United States Airline Transport Pilot International Flight Language Experiences Report 2: Word Meaning and Pronunciation

Prinzo, O. Veronika; Campbell, Alan; Hendrix, Alfred M.; Hendrix, Rudy. U.S. Federal Aviation Administration (FAA) Office of Aerospace Medicine. DOT/FAA/AM-10/7. Final report. April 2010. 44 pp. Figures, tables, references. Available via the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2010s/2010/201007> or from the National Technical Information Service, <www.ntis.org>.


United States Airline Transport Pilot International Flight Language Experiences Report 2: Word Meaning and Pronunciation

The International Civil Aviation Organization (ICAO) has committed itself to developing English language proficiency requirements so that pilots and air traffic controllers in international operations not only speak the same language but also can understand each other with as little ambiguity as possible. The FAA has been conducting focus groups, which are in-depth interviews of a small number of participants, to find out how U.S. pilots perceive the state of play.

The first report, based on a focus group of 48 U.S. pilots, discussed the pilots' backgrounds in international operations and how they prepared for the possible language difficulties in flights to countries whose native language was other than English (*ASW*, 3/09, p. 49).

This, the second report, is based on interviews of pilots in the same focus group as the initial report. It examines the actual experiences of pilots "during times when they experienced language issues that became a barrier to efficient and effective communication between themselves and air traffic control." The report quotes extensively from responses to provide details and the comments' general tone.

Major themes include the following:

Controllers' accented English pronunciation. Only 6 percent of the pilots "often" experienced pronunciation problems, while 30 percent said they "rarely" or "occasionally" experienced them.

Sample comments:

The difficulty I have experienced is increased by accent, dialect and the way the information is presented. The most common examples would be the names of intersections.

I think the French are very proud of their language, and rightly so. When we are cleared to a position or a waypoint, the names are pronounced in French as if delivered to a French pilot. … When we experience problems, it's not that this has necessarily caused me to make a wrong turn or do something incorrectly; the problem that I feel it has caused is the communication and the deciphering of what it is exactly that they want us to do takes a little bit of time and puts us behind the aircraft.

The lack of standardized pronunciation of navigational aids, waypoints, intersections, etc. "There are some fixes that sound similar and are in close proximity to one another," the report says. "Pilots will look them up on their charts and talk among themselves to determine which one the controller said."

Sample comment:

Sometimes I won't catch the numbers in a frequency change, the name of a fix or off-route waypoints because they might be pronounced differently. I've found that the arrival fixes 'MELON' and 'AIRES' spoken by some Asian controllers in English can be very difficult for me to decipher.

Currency of flight time in the operational area is critical to understanding controllers' accented English. "The more often pilots fly to a particular international airport, the greater their knowledge and skill set become," the report says. "Associations between how a word appears in print and its pronunciation are formed based on experience listening to accented-English pronunciation of these words."

Sample comment:

> *I think it's more familiarity and frequency of flying into an area that overcome the problems of understanding the pronunciation and accent. I can lose my experience level by not flying there often enough.*

Poor radios and transmission quality can reduce intelligibility. "Transmissions from ATC [air traffic control] might be weak and sound scratchy, hollow or distorted," the report says. "Some radios might be 60 years old or older."

Sample comment:

> *I have more of a problem with the quality of the radios when flying in the Caribbean and South America than I do understanding the words. We just can't understand anything they're saying, not because of the way they talk but because it doesn't get to the airplane very well. … It [sounds] like it's coming through a wire between two cans — some of it is really, really bad.*

Different phraseology causing ambiguity. Pilots often spoke of being unsure of the meaning of clearances heard in non-U.S. environments: "The most common examples … involved the interpretation of cleared direct and runway surface operations. Phrases such as 'after the arriving aircraft' and 'after aircraft of the moment' appended to 'line up and wait,' and 'into position and hold,' although intelligible, understood and read back correctly, are difficult instructions to follow, as the pilot cannot determine when to safely execute the procedure. Several complained that different phrases were used to indicate the same action, the two most frequently mentioned being 'into position and hold' and 'line up and wait.'"

Sample comments:

> *An example of a phrase or word having two different meanings that I have run into is "cleared direct." In Europe and Central and South America, it can mean direct to fix via flight plan route. In the U.S., it means direct track from present position to fix, and direct from one point to another.*
>
> *The term overshoot is used in the U.K., Canada and other places. They may direct us to overshoot instead of go around. You've heard the one about the [Lockheed] L-1011 pilot? Supposedly, the L-1011 was going into [London] Gatwick and was told to overshoot because there was [an airplane at] position and hold, or line up and wait there. [The L-1011 pilot] said, "Yeah, it's no problem; I'll overshoot that guy and land just past him."*

Pilots often spoke of being unsure of the meaning of clearances heard in non-U.S. environments.

The report concludes with 11 recommendations for alleviating problems mentioned by the interviewed pilots. They include the following:

- "Adopt and adhere to the phraseologies contained in [ICAO] Doc 4444 [*Air Traffic Management — Procedures for Air Navigation Services*] by all of the ICAO member states and the aviation community";
- "Develop additional phraseologies for inclusion into Doc 4444 if the existing phraseologies cannot explain adequately an event involving the safety of an aircraft, provide actions or offer solutions";
- "Develop one standard order for the presentation and delivery of ATC phraseology by ATC, and require that ATC personnel adhere to it. For example, 'Cleared for approach, maintain your altitude' may violate pilot expectations to descend and lead to confusion"; and,
- "Develop aviation training courses that address plain-language proficiency, cultural differences and appropriate phraseology to declare an emergency, assisted handling requests, and assistance during unexpected or unusual situations or events."

— Rick Darby

WEB SITES

Guidelines for Air Safety Investigations

The International Society of Air Safety Investigators (ISASI), <www.isasi.org>

ISASI says that it advances flight safety through communication and education within its community of air safety investigators and others with similar interests. Founded in Washington, D.C., in 1964, the organization has expanded to include affiliated national and regional societies in Australia, Canada, Europe, New Zealand and Russia.

ISASI is a member-supported organization with a members-only section on its Web site. However, some resources are accessible to non-members who make an effort to look for them. Tucked under the "about ISASI" tab, under the "general" entry is a link to four guidelines documents issued by ISASI.

The recently released *Guidelines for the Investigation of Human Factors in Accidents and Incidents* says in its introduction, "Accident and incident investigation presents a real opportunity to examine the interactions between the human and the other system components. While human factors expertise is available to inform investigations, this expertise is not uniformly applied. By developing new guidelines ISASI intends to enhance existing guidance documents now available to investigators. ISASI hopes these guidelines will highlight critical areas which affect human performance." The document was developed by the ISASI Human Factors Working Group and the Transportation Safety Board of Canada. It includes references and a list of recommended reading materials.

Cabin Safety Investigations Guidelines, developed by the ISASI Cabin Safety Working Group, "can provide air safety investigators and other operational personnel with tools to investigate the survival aspects of incidents and accidents." Guidelines for documenting damage to cabin interiors and equipment and conducting flight attendant and passenger interviews can be adapted to operations without cabin attendants. ISASI says, "The guideline is adaptable to any type of occurrence, whether it is a turbulence incident, an evacuation with fire and smoke, or an event that involves water contact."

The purpose of *Air Traffic Services* [ATS] *Investigation Guidelines* is to help ATS investigators identify potential ATS issues, collect and analyze data, draw conclusions, develop reports and make safety recommendations. The ATS Working Group developed the guidelines to be used in conjunction with local and international regulatory and procedural standards and recommended practices.

Investigator Training and Education Guidelines reviews investigator training and education requirements for initial and continuing education, training standards and recommended practices. The document includes terms of reference and definitions.

A link to the organization's *Forum* magazine is found under the "members only" tab, under the "publications and governance" entry. Full-text issues of the quarterly magazine from 2003 to the present may be read online or printed by anyone. Editorial content emphasizes accident investigation findings, techniques and experiences; regulatory issues; industry accident prevention developments; and member involvement, thus reflecting the magazine's intended audience — professional air safety investigators and ISASI members.

Under the same tab is a link to ISASI seminar proceedings, from the first international seminar held in 1970 (with a welcome address by Flight Safety Foundation's Jerry Lederer) to the most recent. Like the magazine, proceedings are downloadable and in full-text.

Finally, under the "members only" tab, researchers will find a new digital collection library. The link takes readers to the Aviation Safety and Security Archives, Embry-Riddle Aeronautical University. The library contains accident reports, photos, correspondence and other important papers from several private collections. Instructions for searching the databases are included.

— Patricia Setze

Mode Mixup

An A320 continued descending after the flight crew initiated a go-around at decision height.

BY MARK LACAGNINA

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

JETS

'TOGA Tap' Was Ineffective

Airbus A320-232. No damage. No injuries.

Before departing from Christchurch, New Zealand, the morning of July 21, 2007, the flight crew was aware that fog might prevent them from landing at Melbourne, Victoria, Australia, and "had planned accordingly," said the Australian Transport Safety Bureau (ATSB) in a report published in February.

As the aircraft neared Melbourne and was sequenced for an instrument landing system (ILS) approach to Runway 27, the crews of "a number" of preceding aircraft conducted missed approaches, the report said.

The A320 pilot-in-command (PIC), the pilot flying, conducted the ILS approach with the autopilots and autothrottles engaged. "At the decision height, the crew did not have the prescribed visual reference to continue the approach to land and commenced a missed approach," the report said. "During the initial part of the missed approach, the PIC did not correctly move the thrust levers to the 'takeoff/go-around' [TOGA] position, and, as a result, the aircraft's automated flight mode did not transition correctly to the go-around mode."

The pilot told investigators that, because the aircraft was light, he did not select TOGA power but, instead, performed a procedure called a "TOGA tap," which involves moving the thrust levers briefly into the TOGA detent and then back to the maximum climb power detent.

However, in this incident, the thrust levers did not reach the TOGA detent before they were moved back to the climb detent.

The PIC said that he heard and felt a thrust increase, and noticed an apparent increase in pitch attitude, but did not hear the expected announcement by the copilot that a positive rate of climb had been achieved.

At this point, the go-around procedure effectively came to a halt, eliminating a timely check of the flight modes indicated on the primary flight display (PFD), the report said.

Checking and announcing the flight modes are among the actions that Airbus requires to be completed simultaneously when a go-around is initiated. However, the operator of the A320 had changed the go-around procedure, moving the flight-modes actions "to a much later position in the procedure," the report said. Confirming and announcing a positive rate of climb were among the actions preceding the flight modes check and callout on the operator's revised checklist.

As a result, the crew did not notice that, because of the PIC's incomplete TOGA tap, the autopilots remained engaged in the glideslope and localizer modes.

The copilot said he noticed that the aircraft continued to descend after the PIC announced the go-around. "Although aware of the requirement to alert the pilot flying of the continuing descent, the copilot was momentarily unable to recall the correct phrase to be used," the report said, noting that the correct phrase is "sink rate."

Not hearing the expected "positive rate" callout and not seeing the flight director pitch-command bars rise on the PFD, the PIC "was unsure of the status of the aircraft," the report said. "[He] subsequently moved the thrust levers to the correct position [the TOGA detent], the flight mode transitioned to the go-around phase, and the aircraft responded normally."

The A320 was within 38 ft of the ground when it began to climb.

The A320 was within 38 ft of the ground when it began to climb — 48 seconds after the PIC's incomplete TOGA tap.

The crew conducted another ILS approach and an uneventful missed approach before diverting the flight to Avalon Airport, near Geelong, Victoria, where the aircraft was landed without further incident.

The report said that the aircraft operator had not analyzed the risks of changing the go-around procedure before issuing the revised checklist. Its safety management system (SMS) did not require formal risk analyses of changes to company policies or procedures.

"As a result of this occurrence, the aircraft operator changed its go-around procedure to reflect that of the aircraft manufacturer and [changed] its SMS to require a formal risk management process in support of any proposal to change an aircraft operating procedure," the report said.

The incident also prompted Airbus to "enhance its published go-around procedures to emphasize the critical nature of the flight crew actions during a go-around," the report said.

Near Collision at an Intersection

Bombardier CRJ200, Pilatus PC-12. No damage. No injuries.

Visual meteorological conditions (VMC) prevailed at Charlotte (North Carolina, U.S.)/Douglas International Airport the morning of May 29, 2009. Air traffic control (ATC) had instructed the flight crew of the CRJ200, which had 46 people aboard, to line up on the approach end of Runway 18L and to await clearance for takeoff.

The pilot of the PC-12, a single-turboprop with three people aboard, was holding for takeoff from Runway 18L at Intersection A, which is about 2,500 ft (762 m) from the approach end of the runway.

According to the report by the U.S. National Transportation Safety Board (NTSB), the ground air traffic controller had told the local air traffic controller that the PC-12 pilot had requested the intersection departure. The ground controller had also noted this on the PC-12's flight progress strip and had circled the notation in red, per procedure.

The report said that the local controller forgot the verbal briefing by the ground controller, did not scan the flight progress strip, did not check the PC-12's position on the airport surface detection equipment (ASDE) display and did not visually scan the runway to ensure that it was clear of traffic before clearing the PC-12 crew for the intersection takeoff — four seconds after clearing the CRJ crew for takeoff.

When the PC-12 entered the runway, the ASDE generated an aural alert: "Warning, Runway 18L occupied." The local controller then radioed the CRJ crew to "cancel takeoff clearance."

However, the CRJ crew had observed the PC-12 moving toward the runway and had initiated a rejected takeoff at about 85 kt, after rolling about 1,600 ft (488 m). The PC-12 pilot taxied the airplane to the left side of the runway when he "recognized what was happening," the report said.

The PIC of the CRJ told investigators that the airplane came to a stop on the runway centerline about 3 ft (1 m) from the PC-12. He said that a collision had been avoided because the PC-12 had "stayed left of the centerline."

'Saw a Man Riding a Lawn Mower'

Boeing 757-200. No damage. No injuries.

Wet weather conditions had hindered grass-cutting operations at Dublin (Ireland) Airport, and it had become imperative to mow tall grass near the localizer antenna and approach lights for Runway 10. Surface winds were forecast to favor that runway for an extended period, so airport and ATC authorities arranged to have the mowing done the night of May 29, 2009.

Mowing at night is preferred because "cutting close to an active runway during the hours of daylight is highly problematic due to the intensity of aircraft movements," said the report by the Irish Air Accident Investigation Unit (AAIU).

The driver of a four-wheel vehicle supervised the operators of three mowing vehicles. The supervisor was able to monitor the local and ground ATC radio frequencies, and to communicate with the controllers via a mobile telephone. The supervisor and the mowing vehicle operators communicated with each other via hand-held radios set to a discrete frequency.

At 0247 local time, the air movements controller (AMC) told the supervisor to discontinue mowing operations because of decreasing visibility and to report when all the vehicles were clear of the field.

The supervisor radioed the mowing vehicle operators to return to the maintenance base, which is on the south side of the airport. He told investigators that he instructed the operator of mowing vehicle T3, which was near the approach end of Runway 10, to "clear the field" and use the airport's south perimeter road to return to the maintenance base.

However, the T3 operator recalled that he had been told only to "vacate the runway area" and, believing that he had "an extra few minutes to vacate the runway," drove along the right side of the runway toward the maintenance base after acknowledging the supervisor's radio message.

At 0249, the flight crew of the 757, inbound on a charter flight from Egypt with 198 passengers and eight crewmembers, radioed the AMC that they were established on the ILS approach to Runway 10 and requested the current ceiling and visibility. The AMC replied that the ceiling was broken at 100 ft and that runway visual range on the touchdown area of the runway was more than 1,500 m (5,000 ft).

The AMC then telephoned the mowing supervisor, who, mistakenly believing that the T3 operator had followed his instructions to clear the runway, reported that all the vehicles had vacated the field.

"The driver of the [T3] mower was unaware that an aircraft was arriving until he heard it on the runway behind him," the report said. The 757 had touched down at 0252 and as it passed by the mower, the copilot told the AMC that there was ground equipment on the runway.

"I don't believe it," the AMC said. "They guaranteed me that they were clear of the runway."

"Could have sworn I saw a man riding a lawn mower," the copilot said.

After the serious incident, the Dublin Airport Authority complied with an AAIU recommendation to ensure that all vehicles operating on or near active runways be equipped with radios capable of monitoring ground and local ATC frequencies, flashing yellow lights and transponders compatible with the airport's advanced surface movement guidance and control system.

Wing Scraped in Crosswind Landing

Airbus A320-211. Minor damage. No injuries.

Freezing rain caused a two-hour delay in the A320's departure from Munich, Germany, for a scheduled flight with 132 passengers and five crewmembers to Hamburg the afternoon of March 1, 2008.

During cruise, the flight crew received a Hamburg automatic terminal information system (ATIS) report of winds from 280 degrees at 23 kt, gusting to 37 kt. They planned for — and later received clearance for — an approach and landing on Runway 23, which is equipped with an ILS, said the report by the German Federal Bureau of Aircraft Accident Investigation.

When the crew reported that they were established on the ILS approach, the aerodrome controller said that the wind was from 300 degrees at 33 kt, gusting to 47 kt.

The report said that a decision to go around would have been "reasonable" because the controller's report indicated that the winds exceeded the maximum demonstrated crosswind for landing, which was "33 kt, gusting up to 38 kt" and presented as an operating limitation in the A320 flight crew operating manual.

The captain asked for the current "go-around rate," and the controller replied, "Fifty percent

The report said that a decision to go around would have been reasonable.

in the last 10 minutes." The controller offered to vector the aircraft for a localizer approach to Runway 33, but the captain replied that they would attempt to land on Runway 23 first.

The crew gained visual contact with the runway at the outer marker. The copilot, the pilot flying, disengaged the autopilot and autothrottles about 940 ft above the ground. She used the wings-level, or crabbed, crosswind-correction technique until the aircraft crossed the runway threshold and then applied left rudder and right sidestick to decrab the aircraft — that is, to align the fuselage with the runway centerline while countering the right crosswind.

The A320 was in a 4-degree left bank when it touched down on the left main landing gear and bounced. Although the copilot applied full-right sidestick and right rudder, the aircraft unexpectedly rolled into a 23-degree left bank. It touched down on the left main landing gear again, striking the left wing tip on the runway, and bounced a second time.

The crew conducted a go-around and landed the aircraft without further incident on Runway 33. The left wing tip, the outboard leading-edge slat and slat rail guides were found to have been slightly damaged during the serious incident, the report said.

Overheated Brakes Cause Fire

Gates Learjet 55. Substantial damage. No injuries.

The Learjet was accelerating through 80 kt when the airport traffic controller told the flight crew, "Appears you have a lot of smoke coming out of your engine." The captain, the pilot monitoring, called for a rejected takeoff (RTO), and the first officer used the wheel brakes and thrust reversers to bring the airplane to a stop on the 10,165-ft (3,098-m) runway at Casper, Wyoming, U.S.

After exiting the runway, the captain conducted a power check on both engines but found no anomalies. He requested and received clearance to taxi back to the runway for another takeoff.

The NTSB report on the March 17, 2009, accident said that the second takeoff was initiated about five minutes after the RTO. The captain told investigators that airspeed was above 80 kt but below V_1 when he heard a loud bang and felt the airplane yaw right and then left more severely. The crew performed another RTO and taxied off the runway near the departure end.

Examination of the airplane revealed fire damage to the left main landing gear and that one of the two tires had burst.

The report said that although the captain did not suspect that the wheel brakes had overheated during the first RTO, the airplane's gross weight was 20,772 lb (9,422 kg), or 472 lb (214 kg) over the maximum brake energy weight for the conditions. The airplane flight manual requires that a high-energy-stop inspection be conducted by maintenance personnel following an RTO above the maximum brake energy weight.

TURBOPROPS

Pilot Incapacitated by Heart Problem

Beech B200 King Air. No damage. One fatality.

After departing from Marco Island, Florida, U.S., the afternoon of April 12, 2009, the King Air was climbing through 6,000 ft, with clearance to 14,000 ft, when the front-seat passenger noticed that the pilot's head was down and both hands were at his sides.

The passenger, who owned the airplane and held a private pilot certificate for single-engine airplanes, tried unsuccessfully to get the pilot's attention. He then declared an emergency on the Miami Air Route Traffic Control Center (ARTCC) frequency and told the controller that the pilot was incapacitated and that he needed to speak with someone familiar with B200s.

The airplane, with four people aboard, continued flying a northerly track and climbed to 17,300 ft in VMC. "Another Miami ARTCC controller talked the owner through the process of disengaging the autopilot, descending and [making] heading changes," the NTSB report said.

The center controller vectored the King Air toward Southwest Florida International Airport in Fort Myers and then handed off the flight to a Fort Meyers approach controller, who provided the owner with information about the landing gear, flaps, power levers and airspeed settings.

"The flight was vectored for a 15-nm [28-km] final approach for Runway 06 … and was landed uneventfully," the report said. "The owner taxied onto a taxiway, where the engines were secured and medical personnel were standing by. … The pilot was noted to have an abnormal heart rhythm during resuscitation efforts and died."

The report said that the pilot, 67, had a history of coronary disease and had received a special-issuance, limited second-class medical certificate following comprehensive cardiovascular evaluation. The medical examiner who performed an autopsy on the pilot determined that the cause of death was "hypertensive and arteriosclerotic cardiovascular disease."

Power Problem Plagues Night Approach

Fairchild Metroliner III. Minor damage. No injuries.

There were two pilots and three medical crewmembers aboard when the Metroliner departed from Auckland, New Zealand, to pick up a patient in New Plymouth the night of March 30, 2009. The air traffic control tower at the destination airport was closed, but the air ambulance operator had arranged to have the runway lights activated before the airplane arrived. The precision approach path indicator, however, was not activated.

"The pilots carried out a visual approach, although that was generally not permitted by the airplane operator at an uncontrolled airport, and without the help of approach slope indicator lights," said the report by the New Zealand Transport Accident Investigation Commission.

While conducting the landing checklist, the pilots became distracted in attempting to determine why the right engine did not respond as expected when the speed/rpm lever was set to "HIGH." Engine speed remained at 97 percent instead of increasing to 100 percent.

"The base turn was carried out close to the airport and involved a high rate of descent that generated ground-proximity warnings," the report said. "Late on final approach, the pilots realized that the airplane's current glide path would result in a landing very close to the runway end."

The PIC, the pilot flying (PF), decided to continue the approach rather than go around because the airplane rolled right when he increased power. He was concerned that the Metroliner might become uncontrollable if he attempted to apply go-around power.

"The PF said that he was holding full left rudder and nearly full left aileron in an attempt to keep the airplane straight, but a main wheel tire crushed a runway edge light 60 m [197 ft] from the threshold, and the airplane then veered off the right side of the runway," the report said. "No one was injured and, apart from minor damage to the tires, the airplane was undamaged."

'The PF said that he was holding full left rudder and nearly full left aileron in an attempt to keep the airplane straight.'

Among the report's conclusions was that "if the pilots had conducted an instrument approach, as the operator had required, the approach would likely have been stable and given them more time to deal with the engine speed issue."

Maintenance personnel were unable to determine the cause of the engine anomaly. The report noted that a few days before the incident, maintenance had been performed on the airplane to correct a fuel-bypass problem that had caused the right engine to malfunction. "A fuel bypass was not considered to have occurred at New Plymouth, and the two events were likely to have been unrelated," the report said.

However, as a precaution, the operator replaced the fuel control unit and propeller governor on the right engine.

Red Gear Light Disregarded

Socata TBM 700C1. Substantial damage. No injuries.

After taking off from Biggin Hill, England, for a private flight to Alderney in the Channel Islands the morning of March 27, 2008, the pilot noticed that the green nose landing gear light and the red landing gear warning light were illuminated. He cycled the gear, but the lights remained on.

"He elected to continue the flight with the gear down, observing the airspeed limitation in the POH [pilot's operating handbook]," said the report by the U.K. Air Accidents Investigation Branch.

When the pilot extended the gear on approach to Alderney Airport, he saw that all three green lights were illuminated and believed that the landing gear was locked down, despite the continued illumination of the red light.

"However, the red light signifies that the gear is unlocked and takes precedence over the three greens," the report said. "Although the correct procedure required the landing gear to be operated manually using the hand pump, it was dependent on the pilot recognizing that a red warning light signifies that the landing gear is unlocked."

The nosegear collapsed at about 40 kt during the landing rollout. The TBM 700 veered off the runway and came to a stop on a taxiway.

Examination of the aircraft revealed that contamination of the nose gear actuator might have prevented the nose gear from locking down and that the actuator was sending anomalous signals to the landing gear control unit indicating that the nose gear was locked both up and down, the report said.

PISTON AIRPLANES

Mental Miscalculation

Piper Navajo. No damage. No injuries.

A company aircraft required maintenance, and the pilot was asked to transport a maintenance engineer as soon as possible from Canberra, Australian Capital Territory, to Albury, New South Wales, the afternoon of May 21, 2009.

The pilot decided that the 280 L (74 gal) of fuel aboard the Navajo was more than sufficient for the 53-minute flight. "The flight to Albury took less time than planned because of a 25-kt tail wind," the ATSB report said.

The repairs took about one hour. The Navajo's gauges indicated that 160 L (42 gal) of fuel remained. The pilot performed a mental calculation and decided that this was sufficient for the return flight. However, the calculation inadvertently had been based on the substantially lower fuel consumption rate for the Beech Duchess that he normally flew.

About halfway to Canberra, the pilot became concerned about the indicated fuel quantity. "He re-evaluated the aircraft's endurance and assessed that the aircraft might not have sufficient fuel to reach Canberra or to return to Albury," the report said. "The pilot assessed that the second half of the flight would mostly pass over inhospitable terrain, where a safe landing would not be possible."

Therefore, he elected to conduct a precautionary landing on a field 50 km (27 nm) southwest of Canberra. "There was no reported damage to the aircraft or injuries to the occupants," the report said.

Training Exercise Ends in Excursion

Piper Seneca. Substantial damage. No injuries.

The airplane was accelerating through 40 kt on takeoff from the 2,600-ft (792-m) airstrip in Plaquemine, Louisiana, U.S., on May 31, 2008, when the flight instructor moved the left throttle to idle to simulate an engine failure.

The NTSB report said that the grass runway was wet with dew and that after moving the right throttle to idle and applying the wheel brakes to reject the takeoff, the student pilot lost directional control of the airplane.

The Seneca slid off the side of the runway and struck a ditch. "Examination of the airplane revealed the left wing had pulled forward, separating the trailing edge from the fuselage approximately 1.5 in [3.8 cm] and buckling the fuselage at the leading edge," the report said.

Seaplane Stalls, Strikes Ridge

Grumman G21 Goose. Destroyed. Five fatalities, one serious injury, one minor injury.

The seaplane was chartered to transport logging-company personnel from Port Hardy to Chamiss Bay, both in British Columbia, Canada, the morning of Aug. 3, 2008.

Port Hardy had 20 mi (32 km) visibility and an overcast at 1,000 ft, and "sunny skies and good visibility" were reported at Chamiss Bay, said the report by the Transportation Safety Board of Canada.

However, a mountain ridge along the 37-nm (69-km) direct route was obscured by clouds. Neither the pilot nor the aircraft was certified to conduct instrument flight rules operations.

A search was initiated after the Goose was reported overdue to land at Chamiss Bay. The wreckage was found at 1,860 ft on a steep, densely wooded slope near Alice Lake, about 14 nm (26 km) from Port Hardy.

Investigators concluded that the aircraft had stalled and struck treetops as the pilot attempted to climb above a ridge that was about 2,000 ft high. The two survivors, who had been seated in the rear of the seaplane, were able to exit through a tear in the fuselage before an intense fire erupted.

HELICOPTERS

Tail Rotor Hits Tower on Takeoff

Sikorsky S-76A. Destroyed. Two serious injuries.

The pilot, who was receiving a proficiency check ride the morning of May 29, 2008, believed that he lifted the air-ambulance helicopter straight up for a vertical takeoff from a hospital rooftop helipad in Grand Rapids, Michigan, U.S., but reports by witnesses and videotape from a security camera showed that the S-76 moved backward about 60 ft (18 m).

The helicopter was about 40 ft in the air when the tail rotor struck a radio tower. It yawed right, and, as the pilot attempted to land on the helipad, the main rotor blades struck the tower-support structure. "The helicopter fell straight down, impacting the hospital roof," the NTSB report said.

The pilot and the U.S. Federal Aviation Administration inspector were able to exit the S-76 before it was consumed by fire.

Weather Briefing Omitted

Bell 430. Destroyed. Four fatalities.

The flight crew, who were conducting their first flight along the route, did not obtain a weather briefing before taking off from Hyderabad, India, for a charter flight with two passengers to Jagdalpur the afternoon of March 8, 2008.

"The crew encountered bad weather [and] continuously kept descending the helicopter," said the report by India's Directorate General of Civil Aviation. The 430 was below the minimum safe altitude for the area when it struck a hill about 27 minutes after takeoff. The helicopter was destroyed by the impact and a post-impact fire.

Fuel Lever Moved Inadvertently

Eurocopter AS 350-B2. Substantial damage. Four fatalities, one serious injury.

The pilot was transporting telecommunications technicians to remote sites near Chickaloon, Alaska, U.S., the morning of April 15, 2008. There were two technicians aboard the helicopter when the pilot landed at a highway rest area to pick up another technician and his stepson, who occupied the front passenger seat.

"The destination site was about 2.5 mi [4.0 km] from the rest area, across a ravine," the NTSB report said.

A witness said that visibility was about 2 mi (3,200 m) in light snow when the helicopter departed from the rest area and descended steeply into the ravine. "He said he thought the descent was unusual, but he did not see any impact and thought the helicopter was working in the ravine," the report said.

A search was launched after the helicopter was reported overdue that afternoon. The wreckage was found the next morning in the ravine. The front-seat passenger survived with head injuries and hypothermia.

Investigators found pre-impact internal engine damage that was consistent with an engine overspeed. The report said that the overspeed likely had occurred when the fuel control lever, which is on the forward cabin floor, had been moved inadvertently to the emergency position by the front-seat passenger's foot or by his backpack.

"According to the manufacturer, inadvertent movement of the fuel flow lever into the forward emergency position can cause the engine to overspeed within seconds," the report said.

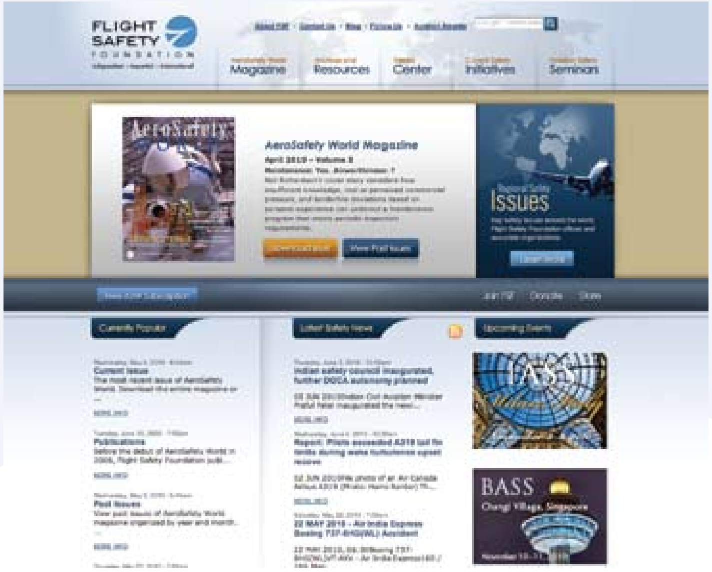
The helicopter apparently had entered a vertical descent after the subsequent loss of power. "Given the rough and uneven terrain and the helicopter's low altitude, a successful autorotative landing was improbable," the report said.

Preliminary Reports, March 2010

Date	Location	Aircraft Type	Aircraft Damage	Injuries
March 1	Bagram, Afghanistan	Airbus A300B4-200F	destroyed	5 none
The A300 was inbound on a cargo flight from Bahrain when its left main landing gear collapsed on landing.				
March 1	Tomé, Chile	Piper Turbo Navajo	destroyed	6 fatal
The Navajo was on an earthquake-relief flight when it crashed while descending to land in Concepción.				
March 1	Stuttgart, Germany	Cessna Citation CJ2	substantial	1 none
An uncontained failure of the left engine occurred during departure. The pilot returned to Stuttgart without further incident.				
March 1	Mwanza, Tanzania	Boeing 737-200	substantial	80 none
The nose landing gear collapsed when the 737 veered off a wet runway on landing.				
March 1	Gaithersburg, Maryland, U.S.	Socata TBM 700	destroyed	1 minor
Visual meteorological conditions (VMC) prevailed when the TBM 700 hit treetops and crashed on approach.				
March 2	DeKalb, Illinois, U.S.	Beech King Air A90	substantial	2 none
The King Air's left main landing gear collapsed during landing rollout.				
March 4	Anchorage, Alaska, U.S.	Boeing 747-400F	substantial	3 none
The flight crew continued the cargo flight to Taiwan after the 747's tail struck the runway on takeoff from Anchorage.				
March 4	Louisa, Virginia, U.S.	Cessna T303 Crusader	destroyed	1 fatal
Witnesses heard abnormal engine noises before the airplane struck a tree and crashed into a house during takeoff.				
March 6	Delta Junction, Alaska, U.S.	McDonnell Douglas 369E	substantial	1 serious, 4 none
The helicopter struck trees during an autorotative landing after losing power during an air taxi flight.				
March 7	Manaus, Brazil	Learjet 35A	substantial	6 none
The Learjet veered off the runway and struck trees after a landing gear problem occurred on takeoff.				
March 7	Guatemala City, Guatemala	Bell B206L-1	destroyed	3 serious, 3 minor
The LongRanger crashed on a soccer field after losing power during an air taxi flight.				
March 8	Bugiri, Uganda	Agusta A119	substantial	1 serious, 7 none
During an attempted precautionary landing at a hospital, the helicopter began to spin, struck trees and touched down hard. The pilot was seriously injured.				
March 10	Tegucigalpa, Honduras	Cessna 421B	destroyed	3 fatal
The 421 crashed soon after the pilot reported a mechanical problem on takeoff in night VMC.				
March 10	Farmingdale, New York, U.S.	Gulfstream III	substantial	5 none
The flight crew said that the airplane was climbing through 35,000 ft when a cabin windowpane separated and was ingested by the right engine. The crew returned to Farmingdale and made a single-engine landing without further incident.				
March 15	Kodiak, Alaska, U.S.	Britten-Norman Islander	destroyed	3 minor
After an intersection takeoff, the pilot lost control of the Islander while attempting to clear terrain off the end of the runway.				
March 17	Bracciano, Italy	Agusta-Bell 412EP	destroyed	1 fatal, 4 serious
The helicopter crashed and sank in a lake during a fire-control training flight.				
March 18	Tallinn, Estonia	Antonov 26	destroyed	1 serious, 1 minor, 4 none
The crew was conducting a go-around due to an unsafe-gear indication when an engine problem occurred. The An-26 struck trees and crashed on a frozen lake.				
March 22	Darwin, Australia	Embraer 120ER Brasilia	destroyed	2 fatal
The Brasilia crashed on a golf course shortly after taking off for a training flight.				
March 22	Moscow, Russia	Tupolev 204-100	destroyed	8 NA
Runway visual range was 450 m (about 1,500 ft) when the Tu-204 struck trees and crashed on approach. No fatalities were reported.				
March 25	Brownsville, Tennessee, U.S.	Eurocopter AS 350-B3	destroyed	3 fatal
After transporting a patient to Jackson, the air-ambulance helicopter crashed in a field on approach to its home base.				
March 30	Ivanovo, Russia	Antonov 74	destroyed	2 serious, 3 minor
The An-74 overran the runway after an engine failed on liftoff.				
March 31	Krasnoyarsk, Russia	Boeing 737-400	substantial	NA
The 737 was in a right turn during a go-around when a compressor stalled in the right engine. The crew regained control after the airplane dived from 4,000 ft to 400 ft. No injuries were reported.				

NA = not available

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



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