AeroSafety WORLD

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CAN YOU STOP?

THE JOURNAL OF FLIGHT SAFETY FOUNDATION
NOVEMBER 2011

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FEAR OF Damage

Lately I've heard a fear expressed increasingly often that what we say about aviation safety issues in public, or in private meetings or even in response to surveys trying to map behavior patterns, has the potential to threaten the industry with legislative or regulatory trouble if the statements get twisted by journalists or, are used in a vicious Internet post that goes viral.

I recognize that a lot of what we discuss is so esoteric, so far removed from the language and frame of reference of most people, that it easily can be misunderstood, sometimes to the point of creating short-term damage. That is one reason we don't release material from our working meetings until issues have been hammered out and vetted. The other reason is that most journalists, even aviation specialists, cannot devote the time needed to wade through all of the discussions, the back-and-forth debates and investigations that eventually arrive at a valuable conclusion.

Journalists need to budget their time carefully. Best case scenario for most is to find information like red meat on the table, ready to slice up and serve. Digging through hours of highly technical discussions in the hope of finding a nugget to report, and maybe misconstrue, typically is not the reality of their situations.

Further, there's already a lot of red meat out there in the public record — in hearings and discussions by numerous legislative, regulatory and safety investigation bodies — that can provide a forum for bomb throwers. These produce content far more damning than anything we might say in any reasonable discussion of pressing industry issues.

A classic and continuing case of misunderstood and/or misrepresented reporting is the flogging being given the adoption of safety management systems, with repeated charges that regulators have turned over their oversight responsibilities to the people they are supposed to be monitoring. Connected with that theme is the claim that "just" culture is nothing more than an excuse to avoid the consequences of failing to comply with the rules.

For the sake of this discussion, it is fairly accurate to say there are two types of journalists who might write a story about aviation safety, or the lack thereof. The first and by far largest, group consists of those who don't know the subject very well and often miss the salient points. This group can produce the occasional headline based on a partially understood issue that will raise a few hackles, but rarely do they create the kind of lasting turmoil we've seen in the past couple of years by, say, the aftermath of the Colgan Air Bombardier Q400 crash near Buffalo, New York, U.S.

Then there is the group who know what they are talking about, mostly aviation industry trade journalists but also a few highly focused general news media folks. For the most part, when the industry is embarrassed by stories from this group, the industry probably deserves to be embarrassed. Face it, while the system is nearly perfect, gaps remain, and gaps need to be filled. If we're called out on these gaps, shame on us.

So don't waste a lot of sleep over information that might leak out of our safety meetings and be picked up for public discussion. It is unlikely that anything we say or do will be nearly as damaging as what's already out there, or will be the instant the next airplane hits the ground hard.

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

Protect the Data

***The discussion of protecting aviation safety data from use in courts of law prompted this exchange between Rutger G. Vossen, board member, technical affairs for the Dutch Airline Pilot Association, and William R. Voss, president and chief executive officer, Flight Safety Foundation*:**

Dear Mr. Voss,

In your Executive's Message (*ASW*, 3/11) you stated that Flight Safety Foundation issued advice to the U.S. Congress which, in your opinion, strikes the right balance between the needs of safety and justice:

> *We suggested that the disclosure of all safety information — including flight data, voluntary reports, data from cockpit voice recorders and flight data recorders, and so forth — should only be allowed if the prosecution can convincingly show that a fair trial cannot be achieved without it.*

The Dutch Air Line Pilots Association (VNV-ALPA) is quite active within the International Federation of Air Line Pilots' Associations and the European Cockpit Association and is a member of Flight Safety Foundation. The VNV has fiercely defended the philosophy that use of flight data recorder (FDR) and cockpit voice recorder (CVR) information should not be allowed in criminal proceedings; we have supported the sector in achieving this in the Netherlands. The Dutch prosecutor has access to the data only if the event is convincingly related to terrorism, murder, manslaughter or hijacking.

The VNV was surprised by your advice. Use of these data in legal proceedings is detrimental to aviation safety and undermines the accident investigation process, whose sole goal is to learn from the tragedy.

In the Joint Resolution Regarding Criminalization of Aviation Accidents, signed Oct. 17, 2006, the signatory organizations, including the Foundation, recognize that the sole purpose of protecting safety information from inappropriate use is to ensure its continued availability to take proper and timely preventative actions to improve aviation safety. No reference is made to the possible use of data in criminal proceedings.

It seems that the Foundation supports the possibility that the prosecutor, if he can convincingly show that a fair trial cannot be achieved without it, will be allowed by a judge to use this information. In our opinion, every prosecutor can use this argument because the use of all data will enhance his research result and is therefore essential. According to advice 2009-022 issued by the Dutch Group of Aviation Specialists, it may be concluded that only aviation specialists are able to weigh the consequences in CVR and FDR data regarding gross negligence and professional behavior; prosecutors are not so capable and therefore might make erroneous conclusions. In the Dutch system, the Civil Aviation Administration, which has the responsibility to review and categorize all safety-related events, consults experts about forwarding a report to the Ministry of Justice.

Your statement that these protections in U.S. law would be quite an accomplishment, as well as providing a model for others, is questionable, taking into consideration that several countries have more stringent rules regarding the use of recorders in legal proceedings. Our global goal should be higher than the basis of the advice mentioned in your article.

The VNV is interested in the arguments and circumstances as to what made the Foundation develop this advice. We therefore kindly ask you for more information regarding the background of the recommendation to Congress.

Looking Beyond Accidents

Dear Mr. Vossen,

First, I have to agree in principle on the protections of CVR data. The Foundation has been vocal on occasions when these data were released for shock value during questionable legal proceedings. I would always agree that the strongest protection for CVR audio is justified. The written transcript of a CVR, however, is difficult to keep out of court.

In my column, I cited the protections for CVR data in U.S. law as an example that might be applied to the protection of *other safety information,* such as voluntary reports, flight data management, etc. I didn't mean to imply one shouldn't argue for stronger protections of CVR data. In the United States, what exists is the best we could get. U.S. law requires that there must be no other means to achieve justice and that the disclosure may only be in the judge's chambers. This rule has existed for decades and has worked well. I understand there has been an exception in the Colgan Air accident that speaks more to the effectiveness of that family group than to the weakness of the provision.

But the real threat to our safety systems is more insidious. Increasingly, courts are requiring airlines to surrender confidential reports in cases in which there was no accident and possibly not even an incident. It could be something as simple as a routine worker's compensation claim for time off. This is something that must be dealt with aggressively. If our safety databases become a hunting ground where prosecutors and litigators routinely search for cases, safety management as we know it will end.

Dealing with this type of disclosure is different than dealing with the aftermath of a tragedy. In this regard, we have sought legal tests to be applied to limit the broad access now allowed. Our first instinct was to suggest that all safety information should forever be prohibited for use in courts. However, such a position would effectively place those in the aviation industry above the interests of justice. In any country, the judicial system will object to a process that gives complete protections to any part of the industry. That approach isn't practical.

Regardless of practicalities, if it were possible to achieve *complete* protection for all safety information, should we accept it? Many of us in the Foundation say, "Probably not." In my experience, while the aviation industry is comprised of some amazing and dedicated professionals, I have met some who are less admirable and would do anything for money.

Where does that leave us? Anyone who lives in a lawful society could be forced to justify his or her actions in a court of law, and the presiding judge would ultimately decide what evidence could be used to prove guilt or innocence. The judge would consider the nation's rules of evidence, rules that someday must take into account the vital nature of protected safety information.

That is why we support provisions to force a judge to explicitly consider whether the disclosure of confidential safety data is the only way to achieve justice, and, if it is, to use the data in a way that limits disclosure. This is not absolute protection, but, ultimately, justice must be achieved. Remember, this request for disclosure may be made to support the defense as easily as the prosecution. Absolute protection of safety data could ultimately cause a miscarriage of justice that would send an innocent aviation professional to prison.

In the end, we must be seen as responsible and pragmatic advocates of both public safety and justice.

AeroSafety WORLD

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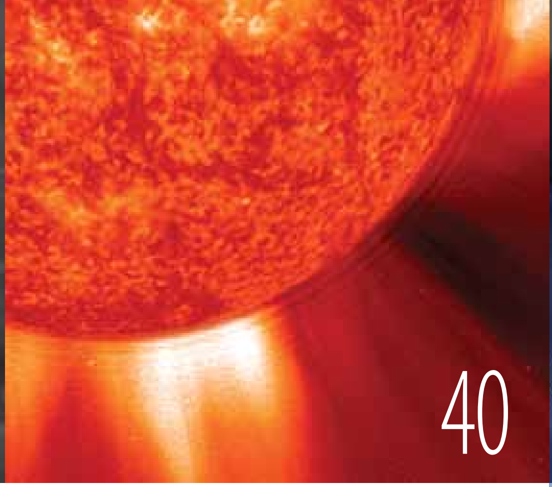

About the Cover
Study shows runway condition reports offer little help in avoiding icy runway accidents.
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Share Your Knowledge

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

The publications staff reserves the right to edit all submissions for publication. Copyright must be transferred to the Foundation for a contribution to be published, and payment is made to the author upon publication.

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Serving Aviation Safety Interests for More Than 60 Years

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

MemberGuide

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NOV. 28–29 ➤ Damage Assessment for System Safety. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/dass.htm>, +1 310.342.1349.

DEC. 1–2 ➤ Aviation Safety Management Systems Overview Workshop. ATC Vantage. Tampa, Florida, U.S. Theresa McCormick, <info@atcvantage.com>, <www.atcvantage.com/sms-workshop.html>, +1 727.410.4759.

DEC. 2–3 ➤ A Practical Approach to Safety Management Systems. Beyond Risk Management and Curt Lewis and Associates. Calgary, Alberta, Canada. Brendan Kapuscinski, <Brendan@beyondriskmgmt.com>, <www.beyondriskmgmt.com/courses.htm#sms>, +1 403.804.9745.

DEC. 5–9 ➤ Safety Management Principles. The MITRE Corp. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <mai.mitrecaasd.org/sms_course/sms_principles.cfm>, +1 703.983.5617.

DEC. 5–6 ➤ A Practical Approach to Quality Assurance and Auditing. Beyond Risk Management and Curt Lewis and Associates. Calgary, Alberta, Canada. Brendan Kapuscinski, <Brendan@beyondriskmgmt.com>, <beyondriskmgmt.com/courses.htm#qa>, +1 403.804.9745.

DEC. 5–6 ➤ Helicopter Ditching, Water Impact and Survivability Workshop. European Aviation Safety Agency. Cologne, Germany. David Haddon, <R4-workshops@easa.europa.eu>, <bit.ly/vlzcNn>.

DEC. 5–16 ➤ Aircraft Accident Investigation. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/aai.htm>, +1 310.342.1349.

DEC. 5–14 ➤ SMS Theory and Application. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <www.mitremai.org>, +1 703.983.5617.

DEC. 7–8 ➤ Fifth Rotorcraft Symposium. European Aviation Safety Agency. Cologne, Germany, <webshop.easa.europa.eu/go/product_info.php?products_id=42>.

DEC. 13–15 ➤ Human Factors Analysis and Classification System Workshop. HFACS Inc. Las Vegas. <dnlmccn@yahoo.com>, <hfacs.com/store/hfacshfix-workshop-las-vegas-nv>, 800.320.0833.

DEC. 19–21 ➤ Threat and Error Management Development. University of Southern California Viterbi School of Engineering. Los Angeles. Thomas Anthony, <aviation@usc.edu>, <viterbi.usc.edu/aviation/courses/tem.htm>, +1 310.342.1349.

JAN. 23–27 ➤ Safety Management Principles. The MITRE Corp. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <mai.mitrecaasd.org/sms_course/sms_principles.cfm>, +1 703.983.5617.

JAN. 23–27 ➤ Organizational Change Workshop. Southern California Safety Institute. San Pedro, California, U.S. <registrar@scsi-inc.com>, <www.scsi-inc.com/OCW.php>, 800.545.3766; +1 310.517.8844, ext. 104.

JAN. 23–FEB. 1 ➤ SMS Theory and Application Plus SMS Development Guidebook. The MITRE Corp. McLean, Virginia, U.S. Mary Beth Wigger, <mbwigger@mitre.org>, <mai.mitrecaasd.org/sms_course/sms_application.cfm>, +1 703.983.5617.

JAN. 29–31 ➤ Safety Management System/Quality Assurance Genesis Symposium. DTI Training Consortium. Orlando, Florida, U.S. <www.dtiatlanta.com/Symposium.html>, +1 866.870.5490.

FEB. 5–8 ➤ Airport Rescue and Fire Fighting Chief's and Leadership School. ARFF Working Group and American Association of Airport Executives. St. Petersburg, Florida, U.S. <events.aaae.org/sites/120204/index.cfm>.

FEB. 6–7 ➤ Business Aviation Safety Conference. Aviation Screening. Munich, Germany. Christian Beckert, <info@basc.eu>, <www.basc.eu>, +49 7158 913 44 20.

FEB. 7–9 ➤ Military Aircraft Accident Investigation Conference. The Boeing Co. and International Society of Air Safety Investigators. Phoenix. <www.militaryasi.webs.com>.

FEB. 8–10 ➤ Human Factors in Aviation Maintenance. Southern California Safety Institute. San Pedro, California, U.S. <registrar@scsi-inc.com>, <www.scsi-inc.com/HFAM.php>, 800.545.3766; +1 310.517.8844, ext. 104.

FEB. 13–24 ➤ Aircraft Accident Investigation. Southern California Safety Institute. San Pedro, California, U.S. <registrar@scsi-inc.com>, <www.scsi-inc.com/AAI.php>, 800.545.3766; +1 310.517.8844, ext. 104.

FEB. 27–MARCH 2 ➤ Human Factors for Accident Investigators. Southern California Safety Institute. San Pedro, California, U.S. <registrar@scsi-inc.com>, <www.scsi-inc.com/HFAI.php>, 800.545.3766; +1 310.517.8844, ext. 104.

FEB. 29–MARCH 1 ➤ European Aviation Safety Seminar. Flight Safety Foundation, European Regions Airline Association and Eurocontrol. Dublin, Ireland. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/aviation-safety-seminars/eass>, +1 703.739.6700, ext. 101.

MARCH 8–9 ➤ Global ATM Operations Conference. Civil Air Navigation Services Organisation. Amsterdam. Anouk Achterhuis, <events@canso.org>, <www.canso.org/events/globalatmoperationsconference2012>, +31 (0) 23 568 5390.

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

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

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

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If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early. Send listings to Rick Darby at Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or <darby@flightsafety.org>.

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

Safety News

Falling Behind

European nations are falling behind in efforts to upgrade the continent's "notoriously inefficient" air traffic management, the International Air Transport Association (IATA) says.

IATA said the problem has affected commitments to improving operational, financial and environmental efficiency.

"Airlines have invested in aircraft and technology to operate at the highest levels of efficiency, oftentimes ahead of what ANSPs [air navigation services providers] are capable of," said IATA Director General and CEO Tony Tyler. "It is the responsibility of the states to ensure that their air navigation service providers are delivering what is needed."

IATA cited a report by the Single European Sky Performance Review Body that said 21 of 29 European countries had not made adequate contributions and projected that the shortfall would "equate to a total cost of €256 million of unrealized savings for 2012–2014."

Information Hunt

The U.S. National Transportation Safety Board (NTSB) has asked Pinnacle Airlines, the parent company of Colgan Air, to turn over "any and all information regarding the training and technical qualifications of the captain and first officer" who were flying a Bombardier Q400 that crashed in 2009.

All 49 people in the airplane and one person on the ground were killed when the airplane struck a house during a Feb. 12 nighttime approach. The airplane was destroyed.

The NTSB said the probable cause of the crash was the captain's inappropriate response to activation of the stick shaker, which led to an unrecoverable stall and the subsequent crash.

NTSB Chairman Deborah A.P. Hersman said the NTSB was disappointed when it learned in October that Pinnacle Airlines had not given investigators internal documents that included criticism of the accident pilot's flying skills. Published reports said that the documents included emails sent by company managers questioning the captain's skills. The papers were made public in connection with wrongful death lawsuits filed by victims' families.

Hersman said that, although the documents apparently were consistent with investigators' findings, "it is critical that the factual record of this accident be complete."

Testing Endorsements

Companies that provide proficiency tests in aviation English may now apply to the International Civil Aviation Organization (ICAO) for an endorsement, ICAO says.

ICAO's endorsement will apply to the test — not the test provider.

"In response to fatal accidents in which the lack of proficiency in English was identified as a contributing factor, ICAO adopted standards to strengthen language proficiency for pilots and air traffic controllers involved in international operations," said Nancy Graham, director of the ICAO Air Navigation Bureau.

She said the ICAO endorsement "makes it easier to achieve that objective by providing states with impartial recommendations on selecting or developing English language tests that comply with our standards."

ICAO said an endorsement remains in effect for three years.

ICAO developed the endorsement service in partnership with several international professional organizations — the International Federation of Air Line Pilots' Associations, the International Federation of Air Traffic Controllers' Associations, the International Language Testing Association and the International Civil Aviation English Association.

© YinYang/iStockphoto

EU–Russian Summit

Officials from the European Union (EU) and Russia say their first aviation summit, held in October in St. Petersburg, Russia, provided a "solid platform" for discussions aimed at building international cooperation in civil aviation.

European Commission Vice President Siim Kallas said the summit marked "a turning point in our aviation relations with Russia, which for too long have not been exploited to their full potential."

The Permanent Mission of the Russian Federation to the EU — established in 1989 to foster cooperation in economic, scientific and technical efforts and in other areas of mutual interest — said the summit was crucial not only in discussions of civil aviation issues but also in establishing business contacts among members of the aviation community.

The EU is Russia's largest international aviation market, with more than 40 percent of Russian passenger traffic destined for airports in the EU. Russia "has the potential to become [the EU's] second-most important air transport market after the United States," the European Commission said.

Controller Scheduling Cited

Air traffic control (ATC) scheduling practices were partly to blame for an incident in which pilots of three aircraft were unable to contact the lone controller working the midnight shift at Ronald Reagan Washington National Airport, the U.S. National Transportation Safety Board (NTSB) says.

In its final report on the March 23, 2011, incident, the NTSB said that the probable causes were the controller's "loss of consciousness induced by lack of sleep, fatigue resulting from working successive midnight shifts and air traffic control scheduling practices."

The report described the incident — between about 0004 and 0028 local time — as a "service interruption."

During the 24-minute period, pilots of two air carrier aircraft and a helicopter, the operator of an airport operations vehicle and air traffic controllers at the U.S. Federal Aviation Administration Potomac Terminal Radar Approach Control facility were unable to establish contact with the controller. Pilots of the two airliners landed without contacting the tower, although they had discussed the situation with approach controllers.

"Post-incident investigation revealed that the controller on duty had the necessary preconditions for the development of fatigue at the time of the event, specifically acute sleep loss in the 24 hours before the event and circadian disruption as a result of working the midnight shift," the report said.

The controller, a 20-year ATC veteran who had become a supervisor in 2005, told investigators that he was "beat, worn out," and that being that tired was not unusual for the fourth midnight shift of the week. He moved around and stretched in an effort to remain alert. Just before the incident, he issued a clearance and noted that three airplanes were inbound to the airport; after that, he "did not recall anything else clearly until waking up," the report said.

He told investigators that his awareness returned when he heard one of the airline pilots calling the tower in a "forceful voice," and he realized only later that he had been asleep. He said that he finished his shift, with "adrenaline … pumping" after the incident, and then reviewed what had happened with ATC managers.

He said he was "professionally embarrassed, shocked, panicked, ashamed" and that he had not realized until he reviewed tower recordings that pilots of two aircraft had landed without being able to contact him.

A physician found no indication of any medical issue that might have contributed to the event but said the controller's sleep patterns during the five previous days "may have played a role."

As a result of the incident, ATC managers implemented a number of changes, including scheduling a second controller on the midnight shift and ensuring that operational personnel are scheduled for nine hours off after working the midnight shift.

In addition, the airlines involved added information to their company manuals for pilots describing alternate means of communication in case of a radio communication failure.

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Proposed Penalties

Pinnacle Airlines is facing $1 million in proposed civil penalties for allegedly operating two airplanes on a total of 63 flights while the airplanes were out of compliance with U.S. Federal Aviation Regulations.

The U.S. Federal Aviation Administration (FAA), which proposed the penalties, said that Pinnacle operated a Canadair Regional Jet on 23 flights between April 30 and May 4, 2009, after flight crewmembers performed a task that was required to be performed by maintenance personnel. The task involved installation and removal of a cable kit — required for an aircraft with an inoperative or missing wheel assembly for the passenger door.

The FAA also said that the airline did not complete inspections designed to identify and track the growth of a crack on the low-pressure turbine case on a Canadair Regional Jet. The airplane was operated on 40 passenger flights between Aug. 25 and Aug. 31, 2010, when it was not in compliance, the FAA said.

The airline has 30 days from the date it received the FAA's enforcement letters to respond.

Wikimedia

Lighting Awareness

U.S. Federal Aviation Administration

Pilots and operators of airport motor vehicles should be given more information about runway status lights (RWSLs) — automated systems being installed at 23 U.S. airports to prevent serious runway incursions, the U.S. Federal Aviation Administration (FAA) says.

FAA Safety Alert for Operators (SAFO) 11009, issued in October, says anyone who taxis an aircraft or operates a motor vehicle within an airport movement area at those airports should be aware of the location and meaning of RWSLs, which provide a visual signal that tells pilots or drivers when it is unsafe to enter or cross a runway or to begin or continue a takeoff.

RWSLs should be discussed during training events and training programs to improve recognition of RWSL signals and knowledge of related procedures, the SAFO says.

"Installation of RWSLs at some of the nation's busiest and most complex airports will increase crew situational awareness on the airport surface and aid in reducing incidences of serious runway incursions," the document says.

RWSLs are red in-pavement lights that illuminate to indicate a potentially unsafe situation, indicated by information provided by ASDE-X (airport surface detection equipment, Model X) on vehicle and aircraft locations.

The first RWSL system was installed in May 2011 at Orlando (Florida) International Airport; 22 other airports are scheduled to receive the equipment by the end of 2016.

Training Airport Fire Fighters

The AviAssist Foundation has completed a five-day aircraft rescue and fire fighting (ARFF) training session at Kilimanjaro International Airport in Tanzania.

The session was scheduled partially in response to audits by the International Civil Aviation Organization that found that recurrent ARFF training occurs less often than required for airport personnel in Africa and that live fire drills also are infrequent, said AviAssist, the Eastern and Southern Africa regional affiliate of Flight Safety Foundation.

Training sessions, conducted in partnership with Groningen Airport Eelde in the Netherlands, emphasized nighttime fire fighting and the use of breathing equipment, along with other subjects, and included live-fire exercises, AviAssist Director Tom Kok said.

"The training directly improved the emergency preparedness of the participating airports," Kok said. "We are keen to continue our contribution to training more professionals that are close to the hazards."

The ARFF training sessions are expected to become annual events, Kok said.

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In Other News …

Flight Safety Foundation President and CEO **William R. Voss** has been honored by the International Air and Safety Bar Association for "fostering air safety and data sharing through the decriminalization of aircraft accidents." The association honored Voss with the third annual Joseph T. Nall Award for "significant contributions to aviation and transportation safety." … The Australian Civil Aviation Safety Authority has established an **electronic flight bag** (EFB) project to coordinate development of standards, rules and guidance materials for the use of EFBs. … The **Agency for Air Navigation Security in Africa and Madagascar** has contracted with Thales to modernize air traffic control centers in six countries — Chad, Congo, Ivory Coast, Madagascar, Niger and Senegal. The updated centers will rely on a multi-sensor tracking system to integrate radars and satellite-based surveillance systems.

Compiled and edited by Linda Werfelman.

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BY DAVID THOMAS

Can You STOP?

A Norwegian study found that runway condition reports may not provide an answer.

There was no correlation between aircraft braking coefficient[1] and the measured or estimated runway friction coefficient[2] in 30 Norwegian runway accidents and incidents over the past 10 years, a study has shown. The report on events on contaminated and slippery runways was published by the Accident Investigation Board Norway (AIBN).[3]

The report discusses a number of factors that likely influence the mismatch between aircraft braking coefficients and runway friction coefficients, including regulatory climate, limitations of friction measurements, meteorology, runway treatment and operational aspects.

The report indicates that in the majority of the 30 accidents and incidents, the stakeholders involved were simply not aware that some of the existing rules and regulations are dated and based on simplifications of the actual physical conditions.

Many of Norway's airports are coastal, with terrain in the vicinity that, when combined with windy conditions and the frequent frost-thaw winter climate, provides a challenging environment for aircraft operations. The report indicates that the increased risk involved in winter operations is not necessarily assessed or managed effectively.

Joint Aviation Requirements–Operations (JAR-OPS) 1.490 states that when operations on contaminated runways are not limited to rare occasions, operators should provide additional measures to ensure an "equivalent level of safety."[4] The AIBN report reveals that this equivalent level of safety, which likely means an equivalent to summer conditions, is not achieved in Norway. Likewise, the report says that the Norwegian Civil Aviation Authority (CAA) apparently lacks an overall risk assessment for winter operations.

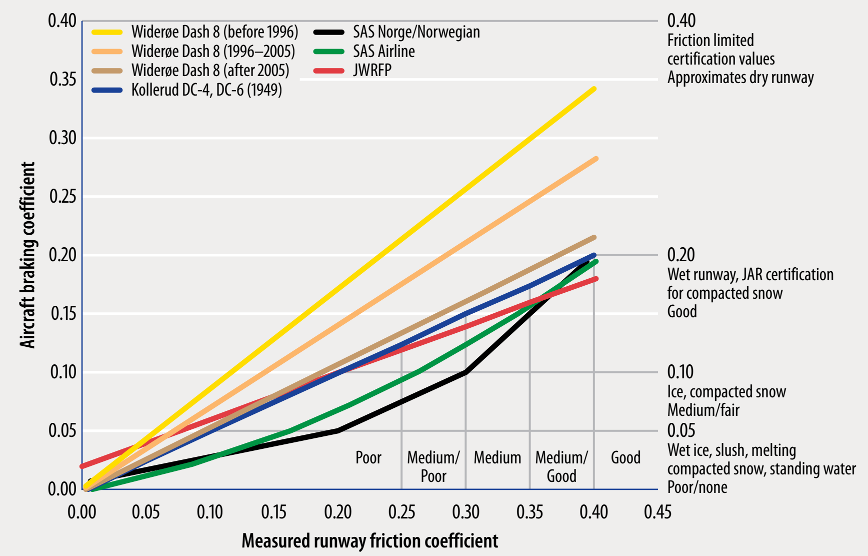
No Correlation

While aircraft manufacturers use different performance values and models to determine braking performance for landing on contaminated runways, they all acknowledge that there is no correlation between runway friction measurements and aircraft braking performance.

The AIBN report notes, however, that airline and airport operators continue to use runway friction measurements as primary data in determining aircraft braking performance. Some Norwegian airlines have even developed or adopted correlation curves combining aircraft braking coefficients and runway friction coefficients (Figure 1). This may not be that surprising considering the International Civil Aviation Organization (ICAO) SNOWTAM (snow notice to airmen) table shows friction values that correspond to estimated braking action. Likewise, a number of modern laptop performance tools have an option for friction coefficient input.

The AIBN has demonstrated that none of the approved friction measuring devices are reliable and that friction values, reported to two decimal places according to ICAO standards, may vary greatly depending on surface temperature and moisture (Figure 2). In dry conditions, the uncertainty is in the order of +/- 0.10; in moist or wet conditions, it is up to +/- 0.20. The report suggests that when a runway is covered with moist or wet contaminants, a braking action of "poor" should be reported.

Friction Coefficient Correlations

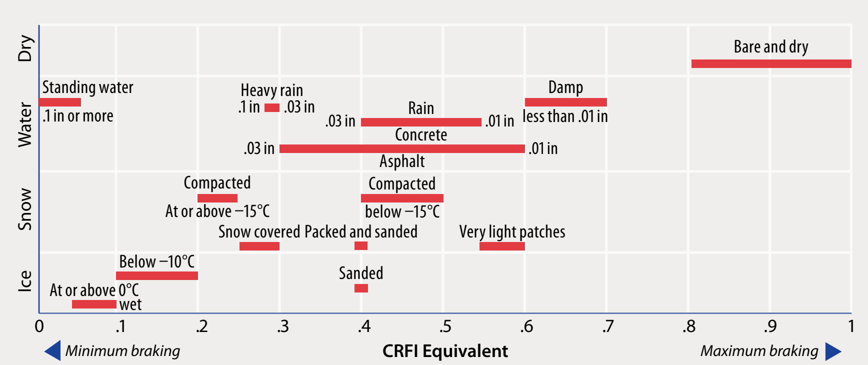


JAR = Joint Aviation Requirements; JWRFP = Joint Winter Runway Friction Measurement Program

Source: Accident Investigation Board Norway

Figure 1

Variables Affecting Friction Values



CRFI = Canadian Runway Friction Index

Source: Accident Investigation Board Norway

Figure 2

Kelvin Spread

In 21 of the 30 accidents and incidents, the spread between air temperature (measured at a height of 2 m above the runway surface) and dew point was 3 degrees C or less. This finding led the AIBN to develop the "3-Kelvin-Spread Rule," which states that at temperatures of 3 degrees C and below, with a temperature/dew point spread of 3 degrees C or less, a runway contaminated by snow or ice may be more slippery than anticipated (see p. 16).

The narrow temperature/dew point spread indicates that the air mass is close to saturation, which is often associated with precipitation or fog.

The validity of the rule may depend on its correlation with precipitation, but it may also, at least in part, depend on the exchange of water at the air-ice interface. Due to the other variables involved — such as surface temperature, solar heating and ground cooling or heating — a small temperature/dew point spread does not always mean that the braking action will be poor. The report says that the rule may be used as an indicator of slippery conditions but not as an absolute. When these conditions exist, it may be appropriate to factor the landing distance further.

Crosswind Guidelines

Of the 30 accidents and incidents, 19 involved crosswinds, which, when combined with a runway with reduced friction and/or only a partially cleared width, impose further limits on aircraft operations. The report stresses that crosswinds remain a major factor when considering directional control on contaminated runways.

The report notes that the operational documentation provided by manufacturers may include recommended crosswind guidelines for contaminated runways. The guidelines are based on analytical computations and simulations; they assume uniform runway surface conditions, steady wind components, an evaluation of what the average line pilot can be expected to handle and a conservative assumption of an aft center of gravity.

However, the guidelines have not been demonstrated as part of the certification process. The AIBN has found that airlines often develop their own crosswind limits, which, although they may be approved by the regulator, might be optimistic. The report cites the Transport Canada table of crosswind versus friction values as a more conservative tool for operators to consider when developing crosswind guidance.[5]

Surface Treatments

Chemicals and sand are used in Norway during winter to increase runway friction. Chemicals are used as deicing agents to melt residues of snow and ice after the runway has been cleared by mechanical devices such as brushes, plows and snow blowers. The chemicals also are intended to serve as anti-icing agents.

The report says, however, that water resulting from melting or precipitation may dilute the chemicals, which in turn could lead to further freezing and the formation of "black ice." Likewise, when the chemicals dry, a viscous, slippery film may form.

When chemicals have been used, the runway is likely to be reported as "wet," although the runway friction may be less than anticipated for a wet runway.

The AIBN has found that sanding, which has been used for many years to treat contaminated runways, is most effective in low temperatures and dry weather conditions, while on wet ice or loose contamination — that is, wet or dry snow and slush — the effects are minimal.

Data Limitations

Data for landing performance on contaminated runways are published either as advisory information in the quick reference handbook or as theoretical certified (i.e., not demonstrated) data in the aircraft flight manual.

Traditionally, contaminated performance data have been based on analytical computations using aerodynamic and engine parameters demonstrated in flight tests, and on an assumed wheel braking model for the runway effect. Consequently, the contaminated runway data may not always represent the performance that will be achieved, and additional safety margins should be considered, the report says.

AIBN analysis indicates that reverse thrust accounts for approximately 20 percent of the total braking force on a contaminated runway. Under European Union operations regulations, a credit for reverse thrust is allowed when dispatching to a contaminated runway. The report acknowledges that reverse thrust often contributes significantly to an aircraft's deceleration on a contaminated runway but says it may be optimistic to allow for the credit, given that EU-OPS 1.485 requires an engine failure to be considered for all flight phases. Clearly, if an engine failure were to occur during the landing phase, one less reverser would be available; hence, there would be less reverse thrust available to aid deceleration. Moreover, late or incorrect selection of reverse thrust has been a significant contributory factor in a number of excursions on contaminated runways.

In an example of how safety factors can be reduced on contaminated runways, the report notes that while reverse thrust definitely aids braking performance on a dry runway, any *degradation* of reverse thrust may significantly reduce braking performance on a contaminated runway.

Improvements at Hand

The report also discusses the limitations of the current tools used to produce runway surface condition reports, the lack of standardization and the subjectivity involved. These issues are exacerbated by flight crews who make decisions about landing performance based on their belief that the reports are the result of accurate scientific evaluation. However, the report says that these limitations and misconceptions may be eliminated with the development of new technology and a re-evaluation of landing performance.

The Integrated Runway Information System (IRIS), a Norwegian project initiated in 2008, has as its primary objective the assessment, prediction and communication of accurate braking action information to flight crews.

The project has collected substantial meteorological and runway surface condition data along with flight data on aircraft braking coefficients (Figure 3). This information has been, and continues to be, analyzed in order to develop a link among prevailing weather conditions, runway surface condition and actual aircraft braking action. The project has received valuable input from Boeing and considerable interest from a number of Norwegian airlines, the Norwegian CAA and the AIBN.

After the Chicago Midway runway excursion (*ASW*, 2/08, p. 28), the U.S. Federal Aviation Administration (FAA) started work in response to findings by the U.S. National Transportation Safety Board that the guidance and regulation related to contaminated runway operations are insufficient. The FAA chartered the Takeoff and Landing Performance Assessment Aviation Rulemaking Committee (TALPA ARC).

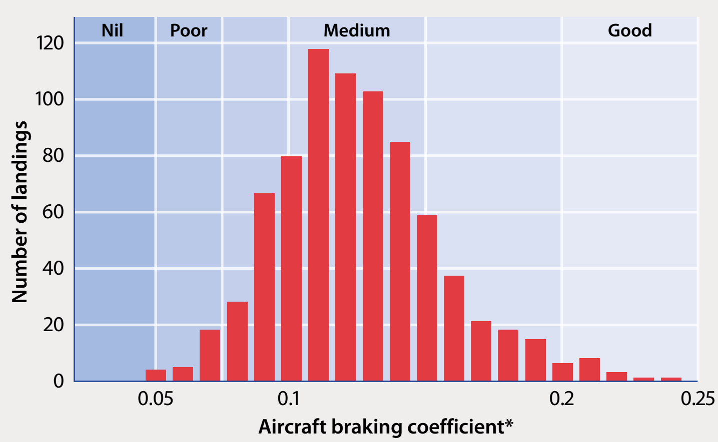
The committee, which completed its work in November 2009, developed the Paved Runway Condition Assessment Table. The table, commonly called the *matrix*, enables airport personnel to categorize runway surface conditions as standard codes that can be provided to pilots in a standardized format and used for contaminated landing performance calculations (*ASW*, 11/10, p. 33). The FAA currently is conducting trials of the matrix with several airlines at several airports in the United States.

Manufacturers have started to change their performance values and models to align with the matrix and are developing *operational landing distances* for in-flight landing performance calculations with consideration given to actual meteorological and runway surface conditions. Operational landing distances reflect the performance that a line pilot may achieve without any additional safety margin, allowing for seven seconds' air distance between crossing the threshold and touching down at 96 percent of the approach speed. Traditionally, actual landing distances have been based on a touchdown speed of 93 percent of the approach speed and may not have been representative of normal flight operations.

The AIBN believes that the work performed by the TALPA ARC and IRIS will lead to accurate runway surface condition reporting.

David Thomas is a captain for a major U.K. airline.

Aircraft Braking Coefficients



* Boeing 737 coefficients measured during the Integrated Runway Information System project in wet and moist conditions including a temperature/dew point spread of 3 kelvin or less.

Source: Accident Investigation Board Norway

Figure 3

Notes

1. *Aircraft braking coefficient* is defined by Boeing as the ratio between the aircraft's braking force and its weight. For example, the coefficient for an aircraft creating 20,000 lb of braking force and weighing 100,000 lb is 0.20. Airbus uses the term *effective friction coefficient* to define the available friction between a braked wheel and the runway surface. Although the values are similar, effective friction coefficients tend to be larger than aircraft braking coefficients for the same type of surface contaminant.
2. *Runway friction coefficient*, or the ratio of forces between an aircraft's tires and the runway surface, is generated by friction-measuring devices.
3. AIBN Report SL 2011/10. *Winter Operations, Friction Measurements and Conditions for Friction Predictions*. May 2011.
4. This provision has been proposed for inclusion in the new European Union aircraft operations regulations.
5. Transport Canada. *Aeronautical Information Manual*. TP 14371. Part 1.6, "Canadian Runway Friction Index."

Valuable Intelligence

BY REINHARD MOOK

Temperature–dew point spread helps pilots anticipate slippery winter landing conditions.

The *3-Kelvin-spread rule,* an aviation rule of thumb for winter operations, can enhance pilots' sense of the actual landing risk level by calling attention to the likelihood that aircraft braking performance will not meet pre-landing calculations. The rule takes advantage of information readily available from aviation routine weather reports (METARs), and its potential value has been recognized in the recent report of an investigation of winter operations[1] by the Accident Investigation Board Norway (AIBN; *ASW,* 10/08, p. 14 and 11/10, p. 30). Nevertheless, its ease of adoption comes at the expense of absolute validity.

The rule emerged from several years of scientific research and analysis in Norway, including my contributions in the report's Appendix J, which explain the micrometeorology of the natural processes involved in water vapor saturation and ice on runways (see "Can You Stop?" p. 12). The impetus was that about two-thirds of the air transport accidents and serious incidents studied by the AIBN (21 of 30) occurred when a difference between air temperature and dew point (or *spread*) of 3 kelvin (K)[2] or less was reported by METARs (see Table 1, p. 17, and Table 2, p. 18 for Kelvin-scale conversions). The statistical probability of that proportion occurring by chance is 0.023 (2.3 percent).

Such a spread means that air containing water vapor is not very far from being saturated. The appendix discusses many factors involved; this article focuses only on saturated water vapor at freezing temperatures.

The rule states, "When the spread (air temperature minus dew point … read at 2-m [6.6-ft] level) is less than 3 K, compacted snow or ice may constitute slippery conditions." The rule has proved especially valuable when air temperatures are lower than 3 degrees C (37 degrees F), in cases of recent or current precipitation, when snow contains liquid water and/or when the surface of frozen contaminants is considerably colder than the METAR air temperatures collected 2 m above the runway indicate.

The rule's underlying research was first reported by an AIBN official in 2007.[3] Before then, insufficient friction on the runway during line operations in Norway often had been attributed only to precipitation or to liquid or frozen water deposited on the runway.

A spread of 3 K or less means the relative humidity is high — often 80 percent or higher, indicating likely precipitation. Often, such a spread occurs in precipitation, intermittent precipitation and precipitation in the vicinity of fog or in conditions conducive to fog.

Water Vapor in Air Above a Runway Affects Braking Friction

AIR TEMP/DP	SVP-W	SVP-I	SVP-DIFF	SVP-PCT	SMR-W	SMR-I	SMR-DIFF	FROST POINT	DP/FP-DIFF
−30°C (−22°F/243.2K)	0.509	0.380	0.129	25.3%	0.318	0.238	0.080	−27.2°C (−17.0°F/246.0K)	2.8°C
−27°C (−17°F/246.2K)	0.673	0.517	0.156	23.2%	0.421	0.323	0.098	−24.4°C (−11.9°F/248.8K)	2.6°C
−24°C (−11°F/249.2K)	0.883	0.699	0.184	20.8%	0.552	0.437	0.115	−21.6°C (−6.9°F/251.6K)	2.4°C
−21°C (−6°F/252.2K)	1.150	0.937	0.213	18.5%	0.720	0.586	0.134	−18.8°C (−1.8°F/254.4K)	2.2°C
−18°C (0°F/255.2K)	1.488	1.248	0.240	16.1%	0.931	0.781	0.150	−16.2°C (2.8°F/257.0K)	1.8°C
−15°C (5°F/258.2K)	1.912	1.652	0.260	13.6%	1.197	1.034	0.163	−13.4°C (7.9°F/259.8K)	1.6°C
−12°C (10°F/261.2K)	2.441	2.172	0.269	11.0%	1.529	1.360	0.169	−10.7°C (12.7°F/262.5K)	1.3°C
−9°C (16°F/264.2)	3.097	2.837	0.260	8.4%	1.941	1.778	0.163	−8.0°C (17.6°F/265.2K)	1.0°C
−6°C (21°F/267.2)	3.906	3.685	0.221	5.7%	2.450	2.310	0.140	−5.3°C (22.5°F/267.9K)	0.7°C
−3°C (27°F/270.2K)	4.898	4.757	0.141	2.9%	3.075	2.986	0.089	−2.7°C (27.1°F/270.5K)	0.3°C
0°C (32°F/273.2K)	6.108	6.108	0.000	0.0%	3.839	3.839	0.000	0.0°C (32°F/273.2K)	0.0°C
3°C (37°F/276.2K)	7.575	NA	NA	NA	4.769	NA	NA	3.0°C (37°F/276.2K)	NA

C = Celsius; F = Fahrenheit; K=Kelvin; hPa = hectopascals; NA = not applicable to ice; AIR TEMP/DP = air temperature (degrees C) for SVP and SMR columns; read as dew point temperature (degrees C) for FROST POINT and DP/FP-DIFF columns; FP = corresponding frost point temperature when air temperature in first column is read as dew point temperature (degrees C); SVP-I = saturation vapor pressure above ice (hPa); SVP-W = saturation vapor pressure above liquid water (hPa); SVP-DIFF = difference (SVP-W minus SVP-I); SVP-PCT = difference as percentage of SVP-W; SMR-I = saturation mixing ratio (grams of water/kilogram of dry air) above ice; SMR-W = SMR above liquid water; SMR-DIFF = difference (SMR-W minus SMR-I); DP/FP-DIFF = absolute difference (dew point minus frost point)

Notes:

Saturation vapor pressure, the maximum water vapor pressure that can exist in air at a given temperature, increases with a rise in air temperature. *Saturation mixing ratio* refers to the mass of water vapor relative to the mass of dry air above either liquid water or ice. This table assumes air temperature measured 2.0 m (6.6 ft) above the runway at an SVP of 1,000 hPa (29.53 in of mercury).

Source: Reinhard Mook

Table 1

Because lower saturation vapor pressure (SVP), the maximum water vapor pressure that can exist at a given air temperature, occurs above ice than above liquid water at a given air temperature, the air temperature–dew point spread exceeds the air temperature–frost point spread under the same physical conditions. Therefore, the spread reported to pilots by METARs is larger than the actual air temperature–frost point spread relevant to the physical processes by which ice forms on a runway. Specifically, air temperature–frost point spread can be close to zero while the METAR's air temperature–dew spread is 1 K or 2 K.

An air temperature–frost point spread will be less than the air temperature–dew point spread. Also, the surface temperature of the runway more often than not will deviate from air temperature. But due to lack of routine runway-surface temperature reports from airports, the 2-m level data must suffice for flight operations.

AIBN-directed research also found, however, that many exceptional cases of uneventful landings on ice or snow occurred even in conditions where a 3-K-or-less spread existed. Therefore, pilots should not assume that such small spreads always mean "definitely poor runway conditions" — instead, the METAR information should be interpreted as an early signal of possible threat.

Applied Micrometeorology

The latest AIBN research essentially recognizes that when the temperature of a solid surface (runway pavement) decreases below freezing and below the dew point of ambient air — that is, the temperature at which water vapor would be saturated above liquid water — water vapor pressure is directed from the air to the solid surface. The lower SVP above ice compared with SVP above liquid water means that hoar frost may appear before the spread drops to 0 K. SVP comes into play because the water vapor in an air mass may be saturated at a temperature 3 K colder than reported in the METAR. A frozen runway surface indicates that these SVP conditions exist in the air mass above the ice.

As hoar frost is crushed and partially melted by the tires of aircraft landing gear, frequently resulting in slippery conditions, the difference between reported dew point and effective frost

Saturation Mixing Ratio Effects

Air Temperature	SMR Change (above liquid water)[1]	SMR Change (above ice)[2]
3°C (37°F/276.2K)	0.930	0.930
0°C (32°F/ 273.2K)	0.764	0.853
–3°C (27°F/ 270.2K)	0.625	0.676
–6°C (21°F/ 267.2K)	0.509	0.532
–9°C (16°F/ 264.2K)	0.412	0.418
–12°C (10°F/ 261.2K)	0.332	0.326
–15°C (5°F/ 258.2K)	0.266	0.253
–18°C (0°F/ 255.2K)	0.211	0.149
–21°C (–6°F/ 252.2K)	0.168	0.114
–24°C (–11°F/ 249.2K)	0.131	0.114
–27°C (–17°F/ 246.2K)	0.103	0.085
–30°C (–22°F/ 243.2K)		

SMR = saturation mixing ratio; Hg = mercury

Notes:

Saturation vapor pressure (SVP), the maximum water vapor pressure that can exist in air at a given temperature, increases with a rise in air temperature. *Saturation mixing ratio* refers to the mass of water vapor relative to the mass of dry air. This table assumes air temperature measured 2.0 m (6.6 ft) above the runway at an SVP of 1,000 hectopascals (hPa; 29.53 in Hg). (1) These changes in SMR occur above liquid water on the runway; they are in grams of water per kilogram of dry air for a 32-kelvin decrease in temperature. (2) These changes in SMR, under the same conditions as the preceding column, occur above ice on the runway.

Source: Reinhard Mook

Table 2

point (the temperature at which the water vapor would become saturated above ice) might become significant to safe flight operations.

In addition to observations about SVP, consideration of saturation mixing ratio (SMR) — the mass of water vapor relative to the mass of dry air — also has helped to explain the 3-K-spread observations. SMRs in Table 2 show that air mass saturation with water vapor may occur with 0 K spread, 3 K spread or any spread between them (see "Interpreting Tables").

This is why the rule refers to a spread of "3 K *or less*" — to remind pilots that the whole interval from 3 K to 0 K is included. In terms of SMR, this means that saturation may occur at the reported air temperature, or in the most extreme case, saturation may occur when the air temperature has decreased by 3 K. With a 0-K spread prevailing, cooling of the air by 3 K means removing water vapor equal to the difference between the SMRs at any two temperatures having that spread.

More research is needed to provide a better understanding of how the transport of water vapor to or from the surface of frozen contamination affects the aircraft braking coefficient. The 3-K-spread rule may depend partly, with a few exceptions, on correlations with precipitation, the vertical gradient of air temperature, the distribution of water vapor close to the surface and the exchange of water at the air-ice interface.

One exception is that the rule does not account for close-to-the-surface, air temperature–dew point phenomena; that is, evaporation or deposition of dew or hoar frost are not explicitly considered by the rule.

Also, for simplicity, the rule does not consider factors such as the vertical gradient of vapor pressure between saturated vapor above liquid water and above ice at the surface, or the difference between air temperature reported at 2 m and surface temperature. Except for the effect of eddy mixing by wind, however, strong gradients in air temperature and vapor pressure will prevail close to any runway surface contaminated by frozen water.

Also affecting the rule's validity is that METARs use rounded numbers, so the actual spread may be even less than reported to pilots. Moreover, by international agreement, the dew point is reported even at temperatures below freezing.

Another exception is that at temperatures below minus 15 degrees C (5 degrees F) or so, the 3-K-spread rule may lose practical value during precipitation-free weather. The reason is that, as air temperature decreases, the frictional properties of ice or compacted snow actually improve considerably. In fact, at minus 30 degrees C, the aircraft braking coefficient on pure ice may be as good as when braking on ice embedded with grains of sand.

However, in the case of precipitation — including accumulations from blowing snow — such an improvement in runway frictional properties could not be expected because there would be an intermediate layer of loose, frozen material. Very slippery conditions may prevail whenever ice or snow has been exposed to the polishing effect of blown particles of ice, especially at low temperatures.

Interpreting Tables

Table 1 shows the SVPs, which are dependent on air temperature, above ice and above water on a runway. The table also shows that in the standard atmosphere, the largest absolute differences in SVP — those greater than 0.260 hectopascals (hPa) — occur from minus 10 to minus 14 degrees C (14 to 7 degrees F). The smaller differences in SVP above water and ice at air temperatures below minus 15 degrees C result from decreasing absolute SVPs.

However, the differences between SVP above liquid water and SVP above ice — expressed as a percentage of SVP-W in the SVP-PCT column — increase with decreasing air temperature. The SVP-PCT column values reflect the increasingly strong bonds of liquid water molecules to the ice with falling temperature.

An example of how close air can be to saturation is that at an air temperature of 0 degrees C (32 degrees F), the SVP above water is 6.108 hPa; the corresponding SVP at minus 3 degrees C (27 degrees F) is 4.898 hPa. That indicates relative humidity of 80 percent for this 3-K spread.[4] At the other extreme of the table — minus 27 degrees C (minus 17 degrees F) and minus 30 degrees C (minus 22 degrees F) — the corresponding SVPs are 0.673 and 0.509 hPa, so this 3-K spread yields a relative humidity of 76 percent, or possibly higher.

To quantify the range of the amount of water covered by the 3-K-spread rule, Table 1 also shows the SMR for air at 1,000 hPa above liquid water (SMR-W column) and above ice (SMR-I column). The largest differences (SMR-DIFF column) in gram water vapor (grams per kilogram of dry air) above liquid water and above ice are found between minus 10 degrees and minus 14 degrees C, that is, the interval with the largest differences in SVP.

The SMR-W and SMR-I columns show that the respective SMRs at minus 3 degrees C are approximately 10 times larger than those at minus 30 degrees C. For that reason, pilots should not expect that the 3-K-spread rule, or any rule based on a certain fixed spread, can be valid for any temperature.

If the SVP of the air above liquid water — and, logically, the SMR — exceeds the corresponding SVP above ice, the frost point for a certain mass of air will be higher/warmer than the dew point. Reading the Table 1 AIR TEMP/DP column values as dew points, the corresponding frost point temperatures are found under the FROST POINT column, and the spreads are found in the DP/FP-DIFF column. Typically, the dew point vs. frost point differences will be on the order of 0.1 K times the Celsius dew point, a negative number. For example, when a dew point of minus 15 degrees C is reported, the frost point will be about 1.5 degrees K warmer — that is, about minus 13.5 degrees C (7.7 degrees F).

The 3-K-spread rule only refers to dew point because, as noted, METARS report only dew point even at air temperatures below freezing. However, by extrapolating frost point from dew point as above, the spread in that example can be estimated to be 1.5 K. As dew point moves toward lower/colder values, however, the difference between dew point spread and frost point spread shrinks. With an extrapolated frost point, the rule becomes useful even at temperatures as low as minus 15 degrees C or so, although other effects should be considered.

Table 2 shows the maximum amount of water removed from air above the runway when the spread is 3 K or less and the air temperature then decreases by 3 K. If the spread is 3 K and the temperature drops by 3 K, no water will be removed. However, if the spread is 0 K, an amount of water equal to the difference of the SMR in the 3-K temperature interval will be the maximum amount of water removed. For example, at air temperature of minus 3 degrees C with a spread of 0 K, a 3 K drop in air temperature would mean water vapor removal of 0.625 g per kg above liquid water and 0.676 g per kg above ice. The actual amount will differ, depending on whether the spread is 3 K or less.

Table 2 also shows that the SMRs above ice decrease more strongly — that is, each change is larger per 3-K drop — than the SMRs above liquid water at temperatures warmer than minus 13 degrees C (9 degrees F). This is consistent with the relationships among SVPs in Table 1.

At temperatures even lower than these, a decrease of SMR above water on a runway will exceed a decrease of SMR above ice on a runway because the air above liquid water is dried less at higher/warmer temperatures than the air above ice. If we compare temperatures near the 0-degrees C freezing point with those near minus 30 degrees C, the SMRs decrease by a factor of about 0.1 for each 3K decrease. This underscores the basic principle that small amounts of water vapor exert significant effects on landing safety at low temperatures, even though the spread may be small.

Reinhard Mook, Ph.D., who retired in 2006 as a professor at the University of Tromsø in Norway, is an independent consultant and researcher. He has conducted micrometeorological field work as an independent researcher at Norway's Svalbard Airport Longyear and analyses of slippery runway incidents for the AIBN, SAS Scandinavian Airlines and the former Norwegian airline Braathens SAFE.

Notes

1. AIBN. "Winter Operations, Friction Measurements and Conditions for Friction Predictions." Statens Havarikommisjon for Transport, Lillestrøm, Norway. May 2011.
2. Each kelvin, the standard unit of measurement for expressing temperature differences in micrometeorology and other physical sciences, has the same magnitude as one degree C. Absolute zero — 0 K on the Kelvin scale — is equivalent to minus 273.15 degrees C (minus 459.67 degrees F).
3. Lande, K. "Winter Operations and Friction Measurements." In "International Cooperation: From Investigation Site to ICAO," Proceedings of the International Society of Air Safety Investigators 38th annual International Seminar (Vol. 11), Aug. 27–30, 2007, Singapore, pp. 31–45.
4. That is, 4.898 divided by 6.108 times 100.

The Big Chill

ACPA conference participants learn how to beat winter at its own game.

BY RICK DARBY | FROM MONTREAL

Winter conditions annually promise — and unfailingly deliver — snow, ice, freezing rain, contaminated runways, frost and other predictable hazards to aviation. As with other threats, modern technology offers mitigation. But the ultimate defense rests on individuals performing their work with "lessons learned" firmly in mind, as several speakers at the two-day International Winter Operations Conference pointed out.

From 1968 to 2004, 22 accidents with 750 fatalities worldwide were associated with ground icing, said Bryon Mask, a former Air Canada captain and now president of Coranna Flight Safety Investigative Services. Like several other speakers, Mask identified the 1989 accident in Dryden, Ontario, as the beginning of a major re-evaluation and upgrading of Canadian regulations and practices.

Air Ontario Flight 1263, a Fokker F28-1000, made a refueling stop at Dryden. Snow began falling heavily. "The captain asked about available deicing, but did not request deicing," Mask said. "At least ½ inch [1.3 cm] of wet layered snow was on the wings at takeoff. As the aircraft

Discussion panel (left to right): James Burin, Flight Safety Foundation; John Horrigan, Air Canada Pilots Association; Chet Collett, Alaska Airlines; Lars Kornsteadt, Airbus.

Rick Darby

began its takeoff run, snow turned to dull grayish opaque ice on the wings." The aircraft was unable to gain enough altitude to clear the trees past the runway end. In the ensuing crash, 21 passengers and three crewmembers died.

A special commission of inquiry was convened, which resulted — after three years — in a 1,712-page report with extensive recommendations. The eventual results included implementation of flight operational quality assurance (FOQA) programs and flight data monitoring programs for Canadian air carriers.

Before Dryden, the Canadian Aviation Regulations said, "No person shall commence a flight when the amount of frost, snow or ice adhering to the wings, control surfaces or propeller of the aircraft may adversely affect the safety of the flight." That somewhat subjective requirement was strengthened post-Dryden to read: "No person shall conduct or attempt to conduct a takeoff in an aircraft that has frost, ice or snow adhering to any of its critical surfaces."[1]

But sooner or later, an aircraft in scheduled commercial service must take off. Many of the speakers discussed ways to ensure the proper conditions.

Deicing and anti-icing fluids are essential to winter operations, but research and testing continue. Arlene Beisswanger, laboratory manager, Anti-Icing Materials International Laboratory (AMIL), University of Quebec, illustrated some of the methodology. "AMIL is the only laboratory in the world that certifies aircraft ground deicing and anti-icing fluids to international SAE standard procedures," she said.

The laboratory contains two icing wind tunnels that can simulate aircraft takeoffs, and five climatic chambers to reproduce freezing rain, freezing drizzle, freezing fog, frost, snow, snow pellets, ice pellets and sea spray. Fluids are tested for anti-icing endurance, aerodynamic acceptability, viscosity at various temperatures and stability in conditions such as a heated wing leading edge or overnight exposure.

Critical flight-surface contamination is not always obvious, and its characteristics not necessarily easy to understand. Two major accidents in the past decade have involved frost, which may look benign. John Horrigan, a captain and winter operations specialist with Air Canada's Flight Safety Division, said, "Frost actively forms when the temperature of the skin surface is below the frost point of the ambient air. The frost point is the temperature at which moisture from the air is deposited as frost on a surface." The frost point can be warmer than the dew point, he added.

"Frost also has a residual phase," he said. "Active frost has ceased, but the skin surface is still below freezing and there is no opportunity for sublimation back to vapor."

Yet another variation is "cold soak frost," caused by a substantial amount of cold fuel

Unseasonable Weather

When is winter? Usually, its conditions move in roughly from October to April in the northern hemisphere. But some long-haul flights follow a polar route, over territory where winter-like environments can extend well into spring and autumn. That is not a problem at cruising altitude, but in the event of a diversion, a crew can find itself suddenly conducting winter operations.

The seriousness of the situation can be amplified because far-northern routes have relatively few airports with runways and support facilities to handle large transport airplanes.

The U.S. Federal Aviation Administration and most other national or regional regulatory agencies require air carriers to obtain approval for polar operations, and a condition for approval is defining a set of alternate airports capable of providing for crew and passenger needs. Edgar Vaynshteyn, a native of Kiev, Ukraine, has built his business Global Aviation Consulting (GAC) on helping operators develop contingency planning for diversions from cross-polar, Russian far east, trans-Asia, trans-Siberia and central Asia routes.

For each potential diversionary airport, GAC has detailed data such as runway length and width, aircraft rescue and fire fighting capability, lighting, deicing equipment, medical facilities, and security — as well as food and hotel accommodations for passengers and crews. The company can contact an English-speaking "go to" person at each supported airport to assist with arrangements.

"We perform airport assessments, maintaining field condition reports and updating our airport information database," Vaynshteyn said. "We're up to date on NOTAMS [notices to airmen], closures and other critical airport information." The company has diversion coordinators available at all times.

—RD

Deicing Then and Now

Gordon

AeroSafety World spoke with one of the conference's presenters, Denis Gordon, who was with Air Canada for 33 years and is now director, standards and procedures, with deicing provider Aéromag2000.

ASW: When did you first become involved with winter operations?

DG: I started in 1977, at 19 years old, being a deicer in a bucket 90 ft in the air. I worked my way up to training and was an instructor for 15 years in the deicing world.

ASW: How did deicing in those days differ from today's methods?

DG: We didn't have much in the way of standards. Information was never passed down to the people doing the frontline work. I'll give you an example. My first day on the job, I was told, "There's the truck, there's the bucket, get in the bucket. There's some handles in there and you just move the handles. You're young, you'll figure it out. There's a hose. When you open the hose, water will come out." In those days, we deiced with hot water. That was my training.

ASW: Did the training become more formal later?

DG: Yes, trainees might have received a couple of cups of coffee, a 15- or 20-minute briefing, some pictures and a 10-question test.

ASW: But deicing training has become more rigorous since then?

DG: Now our Aéromag training could be, depending on who we work for, five days up to five weeks. We do evaluations, we monitor staff regularly. Initial and recurrent, theory and practice.

Another change is that the personnel who can conduct contamination inspections are specified, must be trained and must be qualified. There's more emphasis on the person who does the job, so that the person has the right tools, the right training, and can be certified to be accurate at his position.

With the better education, we're getting more calls for re-inspection. Sometimes, it's a passenger who's noticed ice on the wings, sometimes the flight crew. It may turn out to be no matter for concern, but we're glad to be cautious.

With standards and procedures, we're going into more and more detail. It's a lot different from how we used to write manuals, like a series of bullet points. Now there's more information, which is great. The employees are involved in the deicing operation. They ask questions: "Why this? What about that?"

ASW: Has deicing efficiency improved?

DG: With today's regulations and standards, better training, the better information we're getting, both quality and efficiency are miles ahead. We've gone from taking sometimes 20 or 30 minutes to deice an aircraft, to about eight minutes — that is typical now.

So we've changed a lot in our way of deicing compared with how we used to. Unfortunately, it took a major accident to get us to that point.

ASW: Yes, you mentioned in your presentation that the Dryden accident [p. 20] was a game changer.

DG: It opened a lot of minds. After the accident report, it was evident that there were many holes in the procedures. And even now, the changes keep coming. We see more standards coming in. Why? For one thing, to provide more education for the people working in this field. It's amazing how the deicer himself, right now, knows more than some of the people in charge of the deicing. The frontline deicers get all that education. Pilots get the same training.

ASW: What lessons have been learned?

DG: Training is no. 1, in all its aspects, including the safety of the ground deicing operators themselves. We have employee accidents, too. Employees have lost their lives during deicing operations, such as at Mirabel [Montreal] in 1995. Three deicers died when a Boeing 747 started to move forward while two deicing vehicles were still in front of the horizontal stabilizers. A communication issue caused that accident. After that, procedures were changed. Before, one radio frequency was used for every part of the operation. Now we have different frequencies for every part of the operation we do.

Communication of the kind we're seeing here [at the conference] is also important. We're sharing information — that's another thing we never did before.

With organizations like Air Canada Pilots Association and SAE, if something happens to you, the networking starts and everyone gets involved. Say I'm working in Calgary and some freak thing occurs, I'll let the industry know, to make sure it doesn't happen to anyone else. Sharing information also saves time; before you had to dig and dig and do everything yourself. Now you have a whole group of people. While we're at the conference, we all have one big goal, working for the industry's safety.

ASW: Have airlines changed in connection with deicing?

DG: Yes, as you see in Canada. They're adapting to central deicing facilities, one company taking care of everything, when in the past, it was the airlines deicing their own airplanes. Air Canada had their own deicing, or they'd have their own service provider do the deicing.

ASW: Does the move to central deicing facilities have anything to do with airlines' litigation fears around icing-related accidents?

Photos: Rick Darby

DG: No. It's still the airlines' responsibility to make sure that we're doing our job. We're audited by the airlines. A lot of people think that because we're the provider, the liability goes away. It doesn't. The regulations say the airlines are responsible.

ASW: Which airports in Canada have a single provider for deicing?

DG: Montreal, Ottawa, Vancouver. Edmonton will adopt single-provider deicing next year, Calgary in 2014.

I always think deicing and recovery of fluids go hand-in-hand. A centralized deicing facility has both, so it's good for the environment and good for the operation.

ASW: What sort of oversight do you, as a service provider, face? You mentioned auditing.

DG: Last year Aéromag was audited 54 times by the airlines. In Montreal, we are audited by every major airline that flies there, which is a good thing. The audits are important for me as a provider, because they show me weaknesses that I need to correct. People think audits are bad. But they're not to catch you not doing your job, they're to make sure you are doing your job. We have also started internal audits, auditing ourselves. All of it makes our company stronger.

ASW: What remaining challenges do we face?

DG: Our biggest challenge is that everything seems to be going so well. I'm afraid we're going to stop pushing forward. I remember the first meeting I went to in 2005 at the SAE conference. I'd been in the industry for so many years, I thought I was up on the subject of deicing about as well as anyone. When I sat in that meeting and started listening to the topics, about testing of glycol, testing of aerodynamics, I realized I still had a lot to learn.

—RD

remaining on arrival. "Heat is conducted away from the surface by wing structures that are immersed in the fuel," Horrigan said.

"Type I [deicing] fluid is the most common means of removing frost," Horrigan said. "Unless the minimum fluid thickness of the holdover timetable is applied, active frost can re-accrete within minutes of Type I application. As Type I has no thickeners, even proper application will result in exposure roughly 45 minutes after application."

Earl Weener, member, U.S. National Transportation Safety Board (NTSB), reminded the audience about one of the most dangerous of all winter threats: supercooled large droplets (SLD; *ASW*, 12/09–1/10, p. 32). The investigation of the 1994 crash of an ATR-72 with 68 fatalities at Roselawn, Indiana, U.S., drew attention to SLD. In that accident, SLD produced large ice ridges aft of the deicing boots, causing the ailerons to deflect with a subsequent loss of control.

"Accretions can cause stall or control anomalies at higher airspeed than normally expected," Weener said. "Ice can accrete aft of the ice protection system, and it's sometimes difficult to see or detect."

SLD accumulation lies outside the parameters for continuous maximum icing in U.S. Federal Aviation Regulations Parts 23 and 25, Appendix C. "Airplanes are operating in SLD environments for which they are not certified, particularly in lower layers of the atmosphere," Weener said.

Among the many icing-related recommendations from the NTSB over the years are these: The industry should further develop effective detection and prevention systems; cockpit systems, particularly aural and stick-shaker/pusher warnings, should be developed and installed; pilots should hand fly their airplanes in icing conditions for improved sensitivity to any performance degradation; and pilots should increase speed and activate the boots when entering in-flight icing.

Meeting the season's special demands on aircraft operations was the goal of conference, with the slogan "Safety Is No Secret," hosted by the Air Canada Pilots Association/Association des Pilotes d'Air Canada (ACPA) in Montreal. Organized by Barry Wiszniowski, an Air Canada captain and chairman of the airline's Flight Safety Division, the conference was attended by pilots, technical researchers, deicing service providers, air traffic management specialists, manufacturer representatives and other interested parties. It was the second biannual conference under the same auspices (*ASW*, 10/09, p. 24).

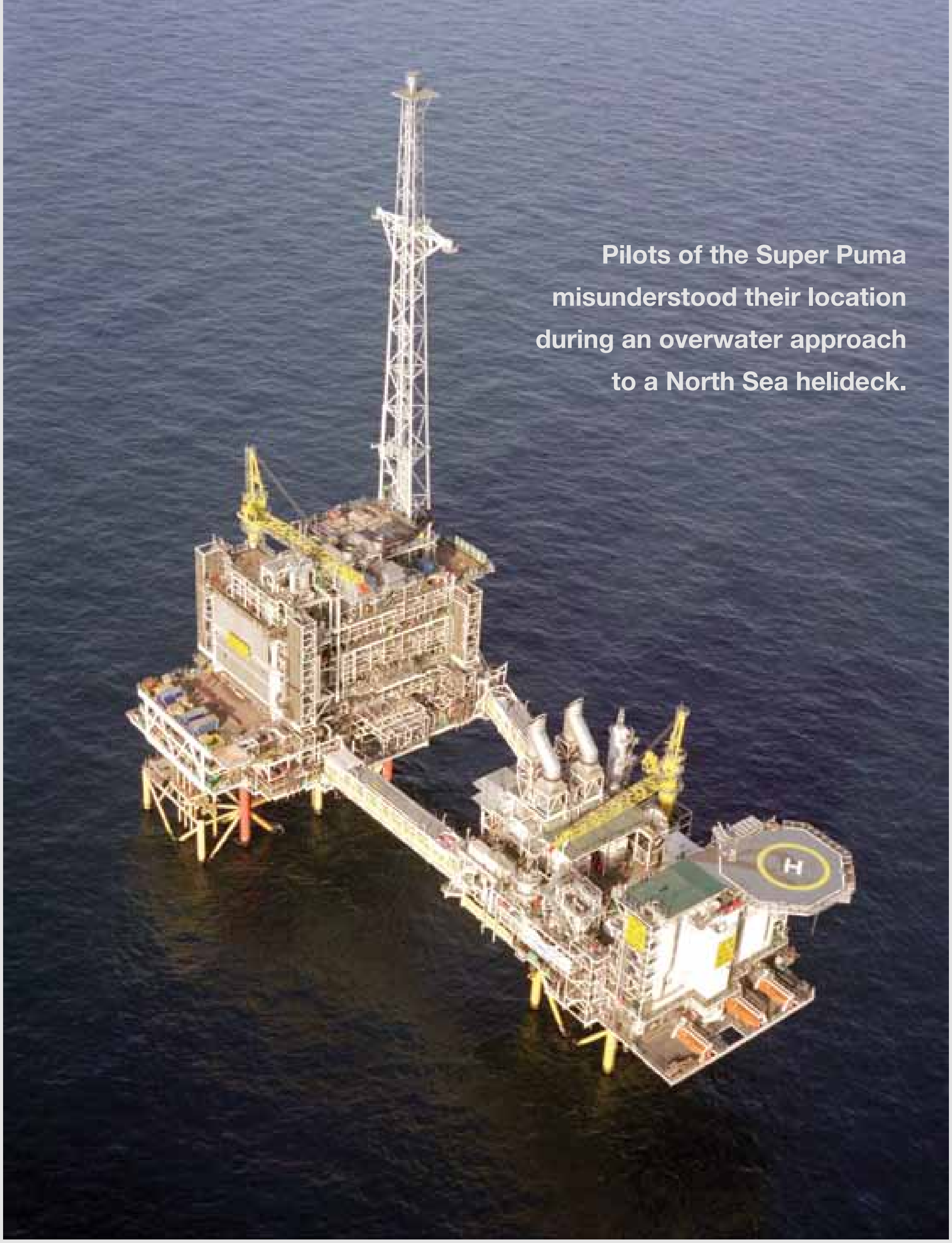
Note

1. Canadian Aviation Regulations 602.11, "Aircraft Icing."

Horrigan, Weener and Mask

Watery Illusions

BY LINDA WERFELMAN



Pilots of the Super Puma misunderstood their location during an overwater approach to a North Sea helideck.

Pilots of a Eurocopter EC225 LP Super Puma were afflicted with visual and sensory illusions and may have been confused by the reflection of an energy production platform on the water when their helicopter descended to the surface of the North Sea during an approach to the platform, accident investigators say.

The helicopter's flotation devices inflated automatically, keeping it on the water's surface, and all 18 people in the helicopter evacuated without injury, the U.K. Air Accidents Investigation Branch (AAIB) said in its final report on the Feb. 18, 2009, accident. The helicopter was destroyed by the impact, the prolonged exposure to salt water and damage incurred during salvage operations.

The AAIB cited three causal factors:

- "The crew's perception of the position and orientation of the helicopter relative to the platform during the final approach was erroneous," and neither pilot realized that the helicopter was descending toward the water. "This was probably due to the effects of oculogravic and somatogravic illusions, combined with both pilots being focused on the platform and not monitoring the flight instruments."[1]

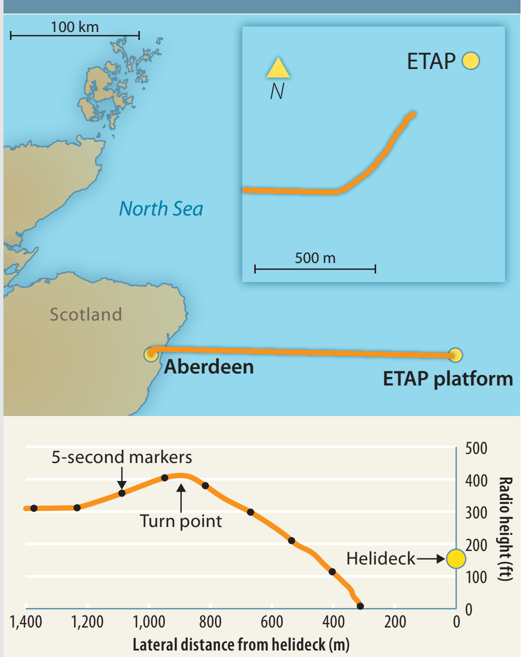
Photo: © BP

- Reduced visibility, probably because of fog or low clouds, "degraded the visual cues provided by the platform lighting, adding to the strength of the visual illusions during the final approach."
- "The two radio altimeter–based audio-voice height alert warnings did not activate. The fixed 100-ft audio-voice alert failed … due to a likely malfunction of the terrain awareness and warning system (TAWS), and the audio-voice element of the selectable 150-ft alert had been suspended by the crew. Had the latter not been suspended, it would also have failed to activate. The pilots were not aware of the inoperative state of the TAWS."

Fog or low clouds during the approach probably degraded the visual cues provided by platform lighting, accident investigators said.

The AAIB cited as contributory the fact that "there was no specified night visual approach profile on which the crew could base their approach and minimum heights, and stabilized approach criteria were not specified." A second contributory factor was that the crew's "visual picture on final approach was possibly confused by a reflection of the platform on the surface of the sea."

Path of Accident Flight



ETAP = Eastern Trough Area Project

Source: U.K. Air Accidents Investigation Branch

Figure 1

The accident occurred at 1837 local time, about one hour after the helicopter's departure from Aberdeen, Scotland, on a scheduled flight to the Eastern Trough Area Project (ETAP) central production facility platform, about 125 nm (232 km) east. That first leg of the flight was to have been followed by a second leg, to the Galaxy 1 rig, 13 nm (24 km) east-northeast of the platform, and then by a return flight to Aberdeen (Figure 1).

The accident flight had been scheduled to allow the transfer of 16 passengers and cargo to the ETAP platform and the oil rig. It was the second flight of the day for both pilots, who at 1600 had completed a round trip of more than three hours between Aberdeen and an oil production vessel west of the Shetland Islands.

They began their preparations for the accident flight shortly after their return.

After starting the helicopter's engines, they found that the airborne collision avoidance system (ACAS) was unable to complete a preflight test; it was turned off before the takeoff at 1742.

The helicopter climbed to 5,500 ft, and at 1755, the commander — the pilot flying — turned the ACAS back on; as he did, a TAWS caution caption was displayed. The caption cleared soon afterward, the AAIB report said, and there was no indication on the multi-function displays of a system failure.

At 1812, ETAP platform personnel told the crew that the cloud base had lowered to 600 ft, down from the 800 ft reported 10 minutes earlier, and that visibility was decreasing from 6 nm (11 km). The commander briefed for a straight-in airborne radar approach to the platform, to begin at 1,500 ft.

The crew saw what they believed to be the ETAP platform, about 13 nm (24 km) away. ETAP personnel, however, reported visibility at the platform of 0.5 nm (900 m). The copilot, who was conducting a passenger briefing, was unaware of the ETAP visibility report.

At 1828, the helicopter descended through 1,500 ft, and at 1831, it was 7 nm (13 km) from the ETAP and descending to 300 ft. Low clouds caused a loss of visual contact with the ETAP, and the crew climbed to 400 ft, regained visual contact and continued the approach.

At 1835, the helicopter descended to 300 ft, and the copilot announced, "just one mile to go." The pilots could see a glowing flare on the platform but had difficulty seeing the platform's lights.

At 1836, when the helicopter was 0.75 nm (1.39 km) from the platform, the commander said, "OK. We'll just stay on this heading, then go up," and the copilot responded, "OK. … If we make a second approach, I reckon we'll get in."

At 350 ft, the crew could again see the flare and diffused platform lights, and at 415 ft, the copilot could also see the green perimeter lighting on the helideck, 166 ft above sea level.

"The commander decoupled the upper modes of the AP [autopilot] and suspended the 'CHECK HEIGHT' aural alert that would have been activated as the aircraft passed through a height of 150 ft," the report said. "However, the selected 150 ft height alert remained in the form of visual warnings displayed on each pilot's primary flight display (PFD)." The report said that company procedures — spelled out in the final approach checklist for other helicopter models but not for the EC225 — called for setting a warning height of 150 ft for offshore approaches and suspending it after the pilots had visual contact with the platform in order to prevent nuisance warnings.

As the helicopter descended through 150 ft … the commander "had the sensation that his approach was fast and high."

The commander began a 20-degree-banked left turn — a descending turn, the copilot said — and he told the copilot that, although he could see the flare and lights on the platform, he could not see the helideck. The copilot initially said that he could "see the deck right in front of us"; seconds later, he lost — and quickly regained — visual contact.

As the helicopter descended through 150 ft — the height at which the "CHECK HEIGHT" alert would have activated had it not been suspended — the commander "had the sensation that his approach was fast and high," the report said. The indicated airspeed was 49 kt, and the descent rate, 1,096 fpm.

At 100 ft, the "ONE HUNDRED" aural alert failed to sound, the report said, noting that — unlike the aural alert at 150 ft — this warning cannot be suspended while TAWS is operating.

"Following this, both pilots' attention was fully focused on the external visual picture," the report said. "The copilot, believing that they were above the height of the deck and in close proximity to it, checked the radar for its range. He then advised the commander, 'OK. Still visual with the deck. Can you see, it's right in front of you, to your right.'

"The commander could not see the helideck and started to ask the copilot 'Who's la…(nding),' but his question was interrupted as the helicopter impacted the surface of the sea."

After the flotation equipment inflated and the helicopter settled on the water, the commander shut down the engines, telling passengers not to evacuate until the rotors stopped. All passengers and crew exited and waited in life rafts for rescue personnel.

On the platform, the helicopter landing officer heard the splash of the helicopter hitting the water and "raised the alarm," as did another platform worker.

At 1957, using radar, a "very weak" signal from a personal locator beacon, forward-looking infrared and visual guidance from platform personnel, the first search-and-rescue helicopter to arrive on the scene located the two life rafts, about 400 m (1,312 ft) from the platform. Other search-and-rescue helicopters arrived, and by 2028, both pilots and all 16 passengers had been rescued.

Navy Training

The commander, 55, had 17,200 flight hours, including 3,018 hours in type, and an airline transport pilot license. He had been trained as a pilot in the Royal Navy, and, after leaving the navy, he flew for more than two decades for commercial operators, primarily in the offshore energy industry; he was hired by the operator in 2007. He completed a night deck competency check in January 2008 and was current in night deck landing practice.

The copilot, 32, had 1,300 flight hours, including 808 hours in type, and a commercial pilot license. He was a flight instructor before he began flying in North Sea offshore energy operations in 2007. He completed a night deck competency check in March 2008 and was current in night deck landing practice when the accident occurred.

Both pilots had completed all mandatory training and testing requirements.

The helicopter, which had accumulated 597 hours before the accident occurred, was manufactured and delivered to the operator in 2008, with modifications for North Sea operations. Later in the year, TAWS and ACAS were installed.

On Feb. 11, a pilot reported the ACAS inoperable, but a self-test was conducted and no problems were found. On Feb. 18, the accident crew flew the helicopter and reported heating and ventilation problems, which were corrected by maintenance personnel before the accident flight.

The report said that, although the helicopter's enhanced ground-proximity warning system (EGPWS) was equipped with the most current database, the investigation found that positions of some oil and gas rigs "might be inaccurate or out of date because they are occasionally moved. This had resulted in 'nuisance warnings.'"

The report also said that EGPWS alerts sometimes are triggered when helicopters approach platforms in high winds. As a result, to reduce the number of nuisance warnings, some operators exclude oil and gas platforms from the database, the report said, noting that the ETAP platform was not included.

Extensive Offshore Experience

The operator had extensive experience in offshore helicopter operations. The company's operations manual did not include a specific night visual approach profile or monitoring procedure, the report said, adding that "the operator relied upon the minimum weather criteria providing sufficient visibility for a visual landing. If these criteria could not be maintained, an [airborne radar approach] was to be carried out."

Company procedures called for an audio warning and visual indications on the PFDs when the helicopter descended below 150 ft, although the audio warning could be suspended before activation. An additional audio warning was generated by TAWS when the radio altimeter showed the helicopter had reached 100 ft; this warning could not be suspended or canceled.

Company trainers had developed "detailed lesson plans" on the importance of using flight instruments and the specific illusions associated with the helicopter pitching up; neither pilot could recall that this information was included in their training, however.

'Judgmental Exercise'

The sun set at the platform at 1701, about 90 minutes before the accident, which occurred in dark night conditions with no visible horizon, the report said. The moon was still below the horizon, and overcast clouds obscured any illumination in the sky.

Mark McEwan/Airliners.net

The Eurocopter EC225 LP Super Puma was destroyed by the impact with the sea, exposure to salt water and damage incurred during salvage operations.

The report noted that an approach to an offshore landing area could be conducted visually, or as an instrument approach to a specified minimum descent altitude followed by a final segment to be flown visually.

"There are significant differences between the visual element of an approach carried out by day in good weather and an approach conducted at night," the report said. "By day, the visual cues afforded by the natural horizon and the disrupted surface of the sea provide good visual references to assist with pilot orientation and closure rate. At night, these visual cues become degraded or are nonexistent, depending on the level of celestial illumination."

The report described the approach to an offshore platform as "a judgmental exercise based on maintaining a height above the installation or vessel until adequate visual perspective of the helideck or structure is acquired to determine a sight-picture of the pilot's required descent angle."

In reduced visibility, pilots also rely on flight instruments, weather radar and/or global positioning system (GPS) equipment.

Pilots typically rely on the elliptical shape of the helideck to assess their approach angle, the report said.

"An optimum approach angle, when combined with a constant reduction in groundspeed, ensures that the helicopter arrives at a committal point from which the pilot can maneuver to a hover above the helideck for landing," the report said.

'Can You See the Deck?'

The report said that the commander had been flying the helicopter and maintaining visual contact with the platform while the copilot monitored flight instruments. However, after the commander asked, "Can you see the deck? That's the problem," the copilot switched his attention away from the instruments to look at the platform.

Pilots typically rely on the elliptical shape of the helideck to assess their approach angle.

"Both pilots were focused on the external visual picture and, not appreciating that the helicopter was descending rapidly toward the surface of the sea, thought they were still above the helideck elevation," the report said. "The commander was progressively pitching the helicopter's nose up. This had the effect of maintaining the platform in the correct position in the windscreen, giving the impression that the descent angle was constant."

If the pilots had been able to measure the helicopter's changing height, range and groundspeed against a specific night visual approach profile, they would have been better able to evaluate their approach, identify an excessive descent rate and maintain a stabilized approach, the report said. Instead, without a visible horizon or other cues, the approach path appeared to be normal until about the last five seconds, when the helicopter appeared to become high and fast.

The report said that nonvisual cues, including the balance system of the inner ear, "would have been inadequate to support detection of the change in helicopter attitude, [and] the helicopter would have continued to feel level."

In addition, "the appearance of the platform and its reflection on the surface of the sea, diffused by the fog/reduced visibility, could have been confusing," the report said. "Orientation and position cues that might have been gleaned from details in the sight-picture were degraded, and the platform could have appeared nearer and lower than it actually was."

The report also characterized a nighttime visual approach to an offshore helideck as "a demanding task that requires a combination of visual and instrument flying," with a final approach track — flown "as close as possible into wind" — that may cause the helideck to be obscured by part of the installation.

"Improvements in the conspicuity of helidecks, using additional lighting to further assist crews in determining the shape and, consequently, an appreciation of their approach angle, is currently being undertaken by the CAA [U.K. Civil Aviation Authority]," the report said. The report added that a proposed light pattern was under consideration.

The report included 23 new safety recommendations from the AAIB, including calls for the CAA to review operator procedures to determine when a flight crew should suspend aural or visual height warnings associated with a radio altimeter and to "ensure that an appropriate defined response is specified when a height warning is activated."

The AAIB also recommended that the European Aviation Safety Agency review the frequency of nuisance warnings from TAWS equipment in offshore helicopter operations and act to improve system integrity.

This article is based on AAIB Aircraft Accident Report 1/2011, "Report on the Accident to Eurocopter EC225 LP Super Puma, G-REDU, Near the Eastern Trough Area Project (ETAP) Central Production Facility Platform in the North Sea, on 18 February 2009." Sept. 14, 2011.

Note

1. The report defined an oculogravic illusion as a "visual illusion that affects the apparent position of an object in the visual field." A somatogravic illusion was defined as a "non-visual illusion that produces a false sensation of helicopter attitude."

Flash of Light

BY LINDA WERFELMAN

Authorities blame the increased availability of relatively cheap high-powered laser pointers for a surge in laser strikes on aircraft.

Drew Wilkens can't forget his flight into Houston on Jan. 15, 2010.

Wilkens, a first officer for ExpressJet Airlines, was the pilot flying an Embraer EMB-145 on approach to Runway 8L at Houston George Bush Intercontinental Airport about 2005 local time, when, he said, "all of a sudden, there was a bright green flash on the right side of the airplane."

Telling his story in October to a Washington conference on laser illumination of aircraft cockpits, Wilkens said he "couldn't see anything but green."

The captain, Henry Cisneros, told the conference — sponsored by the Air Line Pilots Association, International (ALPA) and the Air Transport Association of America — that the laser illumination, which was the second he had experienced in three months, "lit up the whole cockpit … bright green and opaque."

Wilkens said that immediately after the laser illumination — sometimes called a laser strike — he experienced flash blindness, a temporary impairment of vision that interferes with the ability to detect objects. After a few seconds, his vision returned to normal, and he believed that he was fit to fly, although he and Cisneros both said they were concerned that the airplane might be struck by the laser again before they could land.

The crew told air traffic control what had happened and conducted a normal landing. Paramedics told Wilkens that, despite the flash blindness and the subsequent burning sensation in his eyes, he had suffered no lasting damage to his vision.

Their experience was one of 2,800 reported laser illuminations of aircraft in the United States in 2010 (Table 1). The number has increased dramatically since 2005, when the U.S. Federal Aviation Administration (FAA) received 283 reports of laser strikes.

Laser Strikes on Aircraft Cockpits

Year	Number of U.S. Incidents[1]
2010	2,836
2009	1,527
2008	913
2007	590
2006	384
2005	283

[1]In 2011, more than 2,700 incidents had been reported by late October.

Source: U.S. Federal Aviation Administration

Table 1

A similar trend has been reported in Europe, where Eurocontrol said in October that its voluntary air traffic management incident reporting system had received 500 reports of laser illuminations in 2010, compared with eight in 2005. In the United Kingdom, about 1,600 events occurred during the first eight months of 2011, compared with 30 in all of 2007, Eurocontrol said.[1]

Until recently, when pilots encountered laser beams during flight, the lasers were being used legitimately, such as in laser light shows, Eurocontrol said, noting that the International Civil Aviation Organization developed standards to address those conflicts.

"However, laser interference tactics have changed and a harmonized, multidisciplinary and proactive approach is needed to counter this threat," Eurocontrol said, referring to the increasing role of laser pointers in cockpit illuminations.

A Eurocontrol-hosted seminar in October resulted in calls for "timely and effective in-flight and post-flight procedures for dealing with interference," including the development of regulations on production, distribution, purchase and use of lasers; guidance material to help flight crews in responding to laser illuminations; and filters that might block the harmful effects of laser strikes.

Interfering With a Flight Crew

In the United States, the FAA earlier this year began prosecuting people accused of directing laser beams at aircraft under a longstanding regulation that prohibits interfering with a flight crew.

"Usually when people think of interfering with a flight crew, they think of a disruption on the airplane itself," FAA Administrator Randy Babbitt told the Washington laser conference, noting that the regulation has been cited in 18 pending enforcement cases. "This interpretation is clear that directing a laser at an aircraft could cause interference with a flight crew."

Legislation is pending in Congress to make it a federal crime to aim a laser at an aircraft, and some local governments already have implemented laws making it a crime for anyone within their jurisdictions to take such action.

High Power, Low Cost

The FAA and laser safety specialists attribute the increase in the number of reported laser strikes on aircraft to several factors, which the FAA says include "the availability of inexpensive laser devices on the Internet; increased power levels that enable lasers to reach aircraft at high altitudes; more pilot reporting of laser strikes; and the introduction of green and blue lasers, which are more easily seen than red lasers."

Many of those who point laser beams at aircraft do not understand the dangers, Patrick Murphy, executive director of the International Laser Display Association, told the conference.

Laser beams appear to extend no more than a few feet into the air, said Murphy, whose organization promotes the use of laser displays and also, as a public service, sponsors a website — <laserpointersafety.com> — to provide safety information. He noted that, in fact, laser beams can extend many thousands of feet, and that pilots have reported laser cockpit illuminations in aircraft at altitudes as high as 30,000 ft.

When authorities have questioned those responsible for aircraft laser strikes, many have said they acted out of curiosity, Murphy said, quoting one man who "wondered if the beam could hit the belly of the helicopter" and a child who said he aimed a laser pointer at an airplane because "I wanted to say hello to the pilot."

Murphy and others called for intensified efforts to educate the public in general — and especially people purchasing laser pointers — about the aviation-related risks presented by the devices. Among their suggestions were restrictions on sales of laser pointers and institution of a "laser safety tax" of as much as $5 per milliwatt.

They also noted that the U.S. Food and Drug Administration, which regulates laser use, is expected to publish revised standards for laser pointers later this year.

Although lasting eye damage caused by laser cockpit illumination is rare — perhaps eight such injuries in 30 years, Murphy said — there are numerous reports of distraction and temporary visual disruptions such as the flash blindness experienced by Wilkens.

Studies have identified other temporary visual problems, including discomfort in the eyes, blurred vision, dazzle (intense glare) and headache. In some cases, corneal abrasions have resulted, probably when pilots rubbed their eyes after laser exposure.[2]

Quay Snyder, M.D., ALPA aeromedical adviser and CEO of the Aviation Medicine Advisory Service, said that in the past five years, 37 pilots have called his office complaining of afterimages — vision disruptions that linger after an episode of flash blindness — and one pilot has been disabled for two years because laser exposure resulted in a burn on his retina (the eye's light-sensitive innermost lining).

Nevertheless, Snyder said, the greatest hazard often is a pilot's fear of a repeat episode.

For that reason, he also endorsed protective training to help pilots practice the best way of responding to a laser strike (see "Guidelines for Pilots").

Increasing Injuries

Timothy Childs, a supervisory federal air marshal and liaison to the U.S. Federal Bureau of Investigation who has worked to develop interagency efforts to prevent laser strikes, said that, although many people do not understand the dangers presented by "a tiny dot of laser beam," the newest, most powerful laser pointers can produce beams that can be seen for 85 mi (137 km).

When these powerful lasers become more prevalent, one result, Childs predicted, will be an increase in pilot reports of laser-related eye injuries.

Notes

1. Eurocontrol. *Doing Nothing Is Not an Option — Laser Interference Seminar's Conclusions Now Available.* Oct. 12, 2011.
2. Rash, Clarence E.; Manning, Sharon D. "Laser Light Displays, Laser Pointers Disrupt Crewmember Vision." *Human Factors & Aviation Medicine* Volume 48 (November–December 2001). This article cited Sethi, C.S.; Grey, R.H.B.; Hard, C.D. "Laser Pointer Revisited: A Survey of 14 Patients Attending Casualty at the Bristol Eye Hospital." *British Journal of Ophthalmology* Volume 83 (1999): 1,164-1,167.

Guidelines for Pilots

Pilots' organizations recommend the following actions in case of laser illumination of a cockpit:[1,2]

- Look away from the laser beam. If possible, shield your eyes.
- If the other pilot was not exposed, consider transferring control of the aircraft. Engage the autopilot. If the airplane was on approach, consider a missed approach.
- Do not rub your eyes. Rubbing can result in eye irritation or abrasions on the cornea, the transparent dome at the front of the eye.
- Turn up cockpit lights. This helps minimize the effects of further laser illumination.
- Inform air traffic control of the event and include a description of the location of the source of the laser beam, as well as the beam's direction, color and the length of exposure. Follow company procedures for additional reporting.
- If visual symptoms persist after landing, consult an ophthalmologist.
- If you are notified of a laser event while on approach, request a different runway or ask to hold until the threat has been resolved.

— LW

Notes

1. International Federation of Air Line Pilots' Associations. Medical Briefing Leaflet 09MEDBL07, *The Effects of Laser Illumination of Aircraft*. February 2009.
2. Air Line Pilots Association, International. *Laser Illumination Threat Mitigation*.

No Turning Back

Airlines redouble participation in FAA ASIAS analyses that transform proprietary safety data into system-level solutions.

© Andras Brandligt/AirTeamImages

BY WAYNE ROSENKRANS

The Aviation Safety Information Analysis and Sharing (ASIAS) program of the U.S. Federal Aviation Administration (FAA) credits strong airline support and a joint industry-government approach for today's wide acceptance of its strategy, methods and products. Four years after its launch, and contrary to early concerns, ASIAS analysts have not been hampered by the agreed boundaries around use of airline data to identify safety solutions. Rather, the most pressing challenges now include focusing resources based on sound safety-risk assessment and delivering the desired vulnerability-discovery capability, said Jay Pardee, FAA chief scientific and technical advisor for vulnerability discovery and safety measurement programs, and Michael Basehore, ASIAS program manager.

The participation and funding levels are "a testament to the value that both our airline members of the ASIAS community and the FAA attach to our activities," Pardee said. As of November, the program had 40 U.S. airlines contributing experience from flight operational quality assurance (FOQA) programs, aviation safety action programs (ASAPs) or both. Each airline has signed a memorandum of understanding (MOU) with the Center for Advanced Aviation System

Development at the MITRE Corp., a federally funded research and development center, to provide ASIAS analysts network access to de-identified FOQA and ASAP data — and to be among the first to receive analytical reports and industry safety benchmarks derived from aggregation and/or fusion of airline data with more than two dozen non-airline datasets.

"There has been a significant increase, to at least double the number of members in ASIAS since August 2009, further improving the statistical significance of airline datasets and ensuring even more robust coverage of certain locations and aircraft types," Pardee said. "Our basic method of operation is working as effectively as ever. All parties today have a much higher degree of confidence in program governance[1] and preservation of confidentiality and less concern about how ASIAS work is being undertaken."

The amount of proprietary airline data on the network reached a level suitable for statistically significant analyses of system safety issues during the first two years of ASIAS. Continued growth of airline participation has been beneficial, but some missing pieces also have been recognized. "In some instances, we are oversubscribed in certain aircraft types — we already have a lot of FOQA data and ASAP reports for them," Basehore said. "Now, we are focusing more on aircraft types for which we don't have as large a database, and particular geographic locations for which we lack data. But we are still encouraging any airline that wants to participate to join, and we will actively work with them."

At a time of strained government resources, data analysis on this scale has to be conducted using a risk-based strategy focused on strictly limited datasets, Basehore said. As of April 2011, the ASIAS network could analyze FOQA data from 7.7 million flight operations, 83,000 ASAP reports and 30,000 air traffic safety action reports.

"If we spent our time trying to look at every single data point, we would quickly exhaust our funding," he said. "Some issues found obviously are riskier than others. We make sure that we take that into account."

The first recipient of analyses outside of ASIAS — and the entity responsible for developing voluntary, system-level safety enhancements — is the U.S. Commercial Aviation Safety Team (CAST). In October, the FAA received public comments about its intention to collect safety-related data regarding the voluntary implementation of CAST safety enhancements by U.S. air carriers.

Each safety enhancement approved by CAST represents a commitment of sufficient resources by the FAA and the U.S. airline industry, Pardee and Basehore said. For example, aircraft and avionics manufacturers commit to the associated design functionality improvements, and airlines commit to upgrade their aircraft, change flight crew training and take other related actions.

Most of the latest CAST safety enhancements — out of a total of seven derived from ASIAS work — mitigate non-safety-critical traffic-alert and collision avoidance system (TCAS) resolution advisories (RAs) using "local deconfliction of traffic to reduce the frequency of TCAS RAs and opportunities for short-term adjustment to the software algorithms in the TCAS unit itself with ground-based radar inputs changing the sensitivity of TCAS hardware," Pardee said. "We're also looking for opportunities to design the airspace of the future based on the TCAS RA information acquired from meeting with airlines and the work done through ASIAS."

Other safety enhancements described in previous articles (*ASW,* 5/08, p. 25, and 8/09, p. 32) focused on non-safety-critical alerts from terrain awareness and warning systems (TAWS). An example of attention to a relatively old safety issue is continued ASIAS monitoring of routine operations for evidence of controlled flight into terrain (CFIT) risks. Other issues still monitored include the risks — and the effectiveness of CAST safety enhancements — adopted years ago to mitigate approach and landing accidents, runway safety threats, mid-air collisions, loss of control in flight, icing, cargo operations threats and maintenance threats.

ASIAS monitoring of the older CAST safety enhancements has disclosed successes and shortcomings. "There are elements we can identify that warrant further improvement," Pardee said. The recent monitoring of unstabilized approaches, for example, led ASIAS analysts to look beyond the specific airports, runway ends and arrival procedures studied originally. "One CAST safety enhancement encourages pilots conducting an unstabilized approach to execute a go-around, but that is an example of where we need action to further improve how effectively that solution is working," he said.

Vulnerability Discovery

From the outset, the FAA expected vulnerability discovery — the recognition of new risks, threats and system-level precursors not revealed by forensic investigations — to become a core competence of ASIAS. The intention was to ensure constant vigilance for anomalies/atypicalities and to complement the formal directed studies, known risk monitoring, safety enhancement assessment and benchmarking of safety in airline operations.

Developing a true capability for vulnerability discovery has particular importance for the Next Generation Air Transportation System (NextGen), the FAA's transformation of U.S. airspace that, among other things, will replace radar surveillance with satellite-based surveillance of air traffic. The primary role of ASIAS in NextGen implementation is to provide safety assurance information, as defined by the FAA's internal safety management system, Pardee said.

"Vulnerability-discovery capability is a work in progress, still maturing … we are still learning, developing and perfecting our skills," he said. "Our latest methodology has been to use lessons learned from the forensic history to identify undesired aircraft states.

"The forensic history tells us that if an aircraft enters one of these undesired aircraft states, the outcomes usually constitute a safety threat. Accepting that fact — from the perspective of not knowing the causes why an aircraft could enter one of these states — we have begun to exercise our capability to look, for example, at what might be significant FOQA exceedances in roll or bank. We begin by looking through many ASIAS databases just for the existence of undesired aircraft states. We then let the data take us where we should be looking rather than presume we understand all the potential ways that an undesired aircraft state could occur. We look at indications from the data — atypicalities and anomalies, unexpected changes in rate of exceedances and try to compare those."

Current directed studies by ASIAS of area navigation (RNAV) off the ground reflect the early-warning role of ASIAS. "NextGen is based on using RNAV procedures as one of the larger components, so by looking at these procedures as they are introduced, we are out in front in implementing NextGen," Basehore said. "So ASIAS is now looking at RNAV departure and arrival procedures at certain locations, making sure that we fully understand the changes when the FAA puts those procedures in place — how they affect both the operators and the FAA Air Traffic Organization. If we can't get RNAV right, we are not going to get NextGen right."

As methods evolve, new databases are added to the ASIAS network and lessons emerge from analytical experiences, Pardee and Basehore expect to continue shifting the FAA's emphasis from forensic to prognostic aviation safety improvements. The completed directed study of unstabilized approaches was a recent example, and results of directed studies of airport construction threats will be presented to CAST when completed.

"For ongoing study of unstabilized approaches, we now can locate — with the aggregate, de-identified FOQA data — particular airports and procedures that possibly result in a larger number of unstabilized approaches than others," Basehore said (Figure 1). "We also have been able to start looking at weather related to a particular airport and FAA air traffic surveillance data, so we no longer have to rely strictly on the FOQA data from the airlines. For some of the metrics … we are now able to merge data such as what the weather was and what approaches were used on a particular day, so we get a much better feel for what happened than before we were able to fuse and merge all the data sources."

The ASIAS program in the past two years has tapped some federal government datasets for the first time. "Although we still work with the protected FOQA data, we can bring into analytical proximity many more databases — such as all of the FAA radar surveillance data that were not available early in the ASIAS program," Basehore said. "These enable more detailed work and a much more robust understanding. From my perspective, with these new sources and advances in analyzing numerical data and narrative data, we have not encountered any obstacles in carrying out our safety activities while still abiding by the ASIAS principles of governance."

"We have not undertaken any work that we could not complete because of the MOUs regarding de-identified aggregate data," Pardee added.

Infoshare Prominence

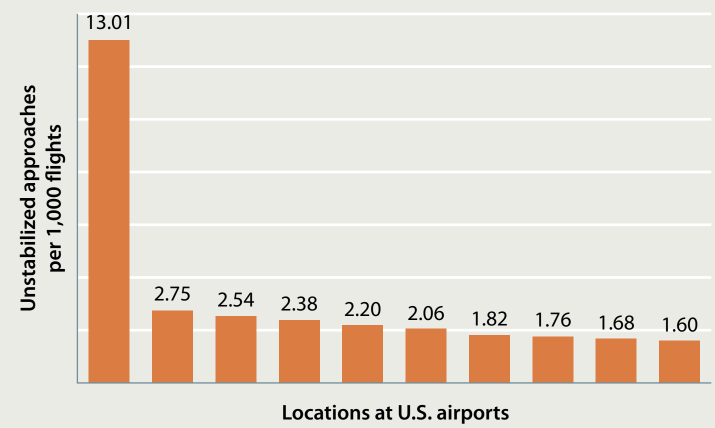
The twice-a-year FAA-industry meeting called Aviation Safety Infoshare has become the primary means of communication about ASIAS activities. The next revision to the compact discs distributed to the industry by CAST will reflect the voluntary safety enhancements adopted based on ASIAS studies of TAWS and TCAS.

"Infoshare meetings are now regularly connected to ASIAS as a source of information and potential concerns for us," Pardee said. "These meetings have become an opportunity for us to engage with many of our ASIAS-member airlines and non-ASIAS members, and for them to share safety issues, concerns and experiences with the FAA and among themselves. … In many cases, Infoshare discussions become an affirmation of what we think we see in ASIAS data and what we have acted on in the past through CAST. In other cases, there may be nuances of a prior issue raised or the beginnings of an operator experiencing something that we haven't focused on before."

Basehore noted that 2011 Infoshare discussions demonstrated an improved integration of voluntary safety programs within individual airlines. Safety teams sent by airlines to these meetings typically had both FOQA representatives and ASAP representatives prepared to jointly present perspectives of the same safety issues, he said. Some U.S. and non-U.S. airlines pointed out ASIAS-like internal techniques of fusing FOQA and ASAP databases (or international equivalents) for company-level analysis.

U.S. airlines that have not signed an MOU still have access to most information generated by ASIAS, and from the FAA's perspective, they have not been impeded in risk-reduction activities. "Airlines that participate directly in ASIAS certainly are involved in the directed studies and receive early safety information," Pardee said. "But a tremendous number of operators — members of ASIAS and non-members — attend Infoshare meetings, listen to our description of the ASIAS products and results and observe the safety information sharing among operators. Safety enhancements and solutions are shared by ASIAS throughout the airline community and all of their associations, so there are multiple paths to receiving ASIAS-developed, CAST-executed products."

ASIAS Comparison of Unstabilized Approaches by Location



ASIAS = Aviation Safety Information Analysis and Sharing

Notes: By aggregating metrics from de-identified airline-flight datasets with locations, air traffic, weather, approach procedures and other data known to ASIAS analysts, an atypical rate emerged for focused study. Representative data for 10 of 20 locations are shown, and airport identification, dates and criteria for identifying unstabilized approach events were omitted in this excerpt from an ASIAS-generated chart.

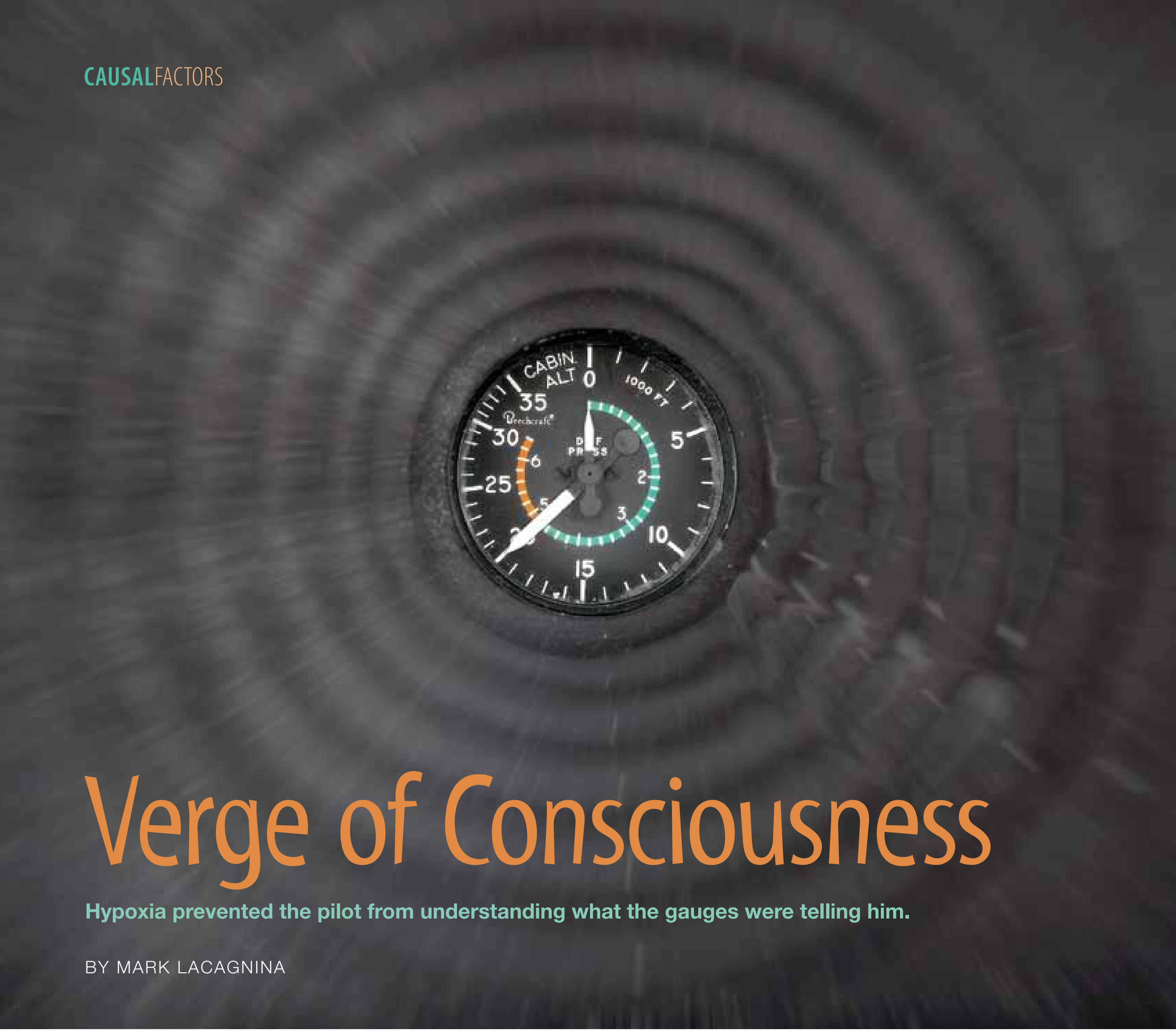
Source: U.S. Federal Aviation Administration

Figure 1

At the international level, data-sharing and analytical processes are maturing under 2011 agreements among the European Union, FAA, International Air Transport Association and International Civil Aviation Organization (ICAO), he added. "We are sharing common taxonomies between regulatory authorities and ICAO, for example," Pardee said. "We have defined things like the classification of incident precursors as well as the criteria … for applying digital measurements to events like unstabilized approaches, and we have shared definitions more universally. Non-U.S. entities similar to ASIAS are beginning to use the same taxonomies. The FAA partners in the sharing of safety information and measurements of the effectiveness of safety solutions from CAST and ASIAS with other CAST-like safety organizations, such as emerging regional aviation safety groups sponsored by ICAO."

Note

1. The basic principles of governance are using data solely for the advancement of safety, using de-identified airline data, non-punitive reporting and approval of analyses by the FAA-industry ASIAS Executive Board.



Verge of Consciousness

Hypoxia prevented the pilot from understanding what the gauges were telling him.

BY MARK LACAGNINA

An improperly adjusted safety switch that rendered the aircraft's pressurization system inoperative, an incorrectly wired cabin altitude warning switch that disabled a warning light and the pilot's ineffective systems monitoring while distracted by an autopilot problem early in the flight were among the factors that led to a dangerous encounter with hypoxia, according to the Australian Transport Safety Bureau (ATSB).

Starved of oxygen during the climb to cruise altitude, the pilot's mental functioning deteriorated to the point where he could not resolve a troubling indication on the Beech King Air C90's cabin altimeter. As confusion mounted, he fixated on a navigation readout that he incorrectly interpreted as an indication of an unusually low groundspeed.

That mistake, however, actually saved the day: Descending to escape the perceived gale of a head wind, the pilot entered a more oxygen-rich environment, where his brain eventually began to work again.

"Had the pilot continued at cruise altitude for an extended length of time, it is probable that he and the passenger would have lapsed into an

Photo: ©Bill Ryan, photo illustration: Susan Reed

unconscious state, from which neither may have recovered," the ATSB report said.

The July 16, 2009, incident was cited by ATSB as yet another example of the insidious nature of hypoxia and why all pressurized, turbine aircraft certified for single-pilot operation should provide aural as well as visual warnings of cabin pressurization problems.

'Pretty Busy'

The incident occurred during a charter flight in Western Australia — from Perth to Wiluna, about 390 nm (722 km) northeast.

The pilot held a commercial license and a command multiengine instrument rating. He had 3,140 flight hours, including 2,619 hours as pilot-in-command. "He had a total of 470 hours' flight experience in turboprop aircraft, of which 80 hours were on the King Air C90 aircraft type," the report said, noting that he recently had completed a check flight in a Beech 1900D. His age was not specified.

The aircraft, VH-TAM, departed from Perth at 1026 local time. "The weather for the departure and climb to the planned cruise altitude of Flight Level (FL) 210 indicated instrument meteorological conditions with moderate turbulence, rain and cloud," the report said.

The cabin altimeter reading caused concern … and confusion.

The pilot told investigators that he checked the pressurization system twice during the climb, at 6,000 ft and at 10,000 ft, the transition altitude. The checks typically encompass three devices mounted on the King Air's center pedestal: the pressurization system controller, which is used to set the desired cabin altitude and cabin rate of climb; the cabin rate-of-climb indicator; and the cabin altimeter, which shows the differential between external atmospheric pressure and cabin pressure, as well as the cabin altitude.

The report provided no details about the check at 6,000 ft. It said that the pilot recalled seeing 300 fpm on the cabin rate-of-climb indicator but did not remember checking the controller or cabin altimeter while climbing through 10,000 ft.

"The pilot indicated that during the transition checks, he was 'pretty busy,' as the aircraft was encountering rough weather with moderate turbulence," the report said. "He was also having difficulties with the aircraft's autopilot at that time."

'Unable to Reason'

Recorded air traffic control (ATC) radar data showed that the King Air reached FL 210 about 18 minutes after departing from Perth. "The pilot reported that the autopilot difficulties continued once at FL 210, with the system taking several minutes to engage the altitude-hold function," the report said.

The pilot also told investigators he noticed that the cabin altimeter was indicating 20,000 ft. "He recalled feeling some concern at this but at the time being unable to reason what to do to alleviate that concern," the report said.

If the pressurization system had been set properly and was functioning properly, the indicated cabin altitude at FL 210 should have been about 8,000 ft. An indication of 20,000 ft meant that the cabin was not pressurized.

The pilot also recalled that while reprogramming the global positioning system (GPS) receiver in response to an amended route clearance from ATC, he became "fixated" on a GPS readout that he thought was a groundspeed indication.

He actually was looking at a distance-remaining indication. The report did not specify

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An incorrectly adjusted squat switch prevented the cabin from pressurizing when the landing gear was retracted.

the figure, but it apparently was low enough to cause the pilot to perceive that the aircraft had a 100-kt head wind. (The aircraft actually had a slight tail wind.)

"Consequently, the pilot contacted ATC, requesting a descent to FL 190 in an attempt to improve his groundspeed," the report said. "That request was granted."

The aircraft had been at FL 210 for 11 minutes when the pilot began the descent. "At 1107, about 10 minutes after becoming established at FL 190, the pilot queried ATC about the perceived strong head winds," the report said. "ATC indicated that no one else had reported those winds."

Shortly thereafter, the pilot requested and received clearance to descend to FL 140, which he subsequently amended to FL 150. The King Air reached that level at 1124, or 58 minutes after departing from Perth.

"The pilot clearly recalled seeing 15,000 ft on the outer scale of the [cabin] altimeter several times but noted that he was still unable to understand the reason for that reading," the report said.

After about 30 minutes at FL 150, and about 80 nm (148 km) from the destination, the pilot realized that the King Air's cabin was not pressurized and that he was experiencing hypoxia.

"The pilot immediately conducted a descent to below 10,000 ft, contacting ATC and indicating that he had left FL 150 on descent for Wiluna," the report said. He subsequently landed the aircraft without further incident.

'Hairline' Switch

The safety switch, or squat switch, mounted on the King Air's left landing gear strut is designed to be compressed when the gear is extended, causing the safety valve — a backup cabin pressurization outflow valve — to open fully, ensuring that the cabin is depressurized before landing. This function prevents structural damage that could occur if the aircraft is landed with the cabin still pressurized.

When the landing gear is retracted on takeoff, the safety switch extends and causes the safety outflow valve to close, enabling the cabin to pressurize by retaining in a controlled manner the conditioned bleed air supplied by the engines.

The safety switch on the incident aircraft was not adjusted correctly. "Maintenance personnel [who examined the switch said] that the adjustment was found to be on a 'hairline' setting, with the effect that the switch sometimes worked correctly and at other times did not," the report said.

The switch apparently did not extend sufficiently to close the safety outflow valve on takeoff for the incident flight. Thus, although the cabin pressurization controller had been set correctly, the cabin did not pressurize, and the pilot did not detect the anomaly.

Crossed Connection

The "ALT WARN" annunciator light atop the instrument panel should have illuminated when the aircraft climbed above about 10,500 ft. The pilot recalled that the light had illuminated when he pushed the "PRESS TO TEST" button on the annunciator panel during his preflight preparations. The report noted, however, that this tests only the light bulbs; it reveals nothing about the status of the systems themselves.

In this case, the cabin altitude warning system was inoperative because its activating switch was miswired.

The switch had been replaced in December 2007, during routine maintenance that included a test of the cabin altitude warning system mandated by an airworthiness bulletin, ASW 21-1, issued by the Australian Civil Aviation Safety Authority (CASA) in 2002.

"The maintenance personnel indicated that the new switch was not tested prior to fitment, as its supporting documentation indicated that it was serviceable," the report said.

The switch has three terminal posts, of which only two must be electrically connected to the warning system. One of the two wires had been connected to the wrong post on the old switch, rendering the warning system inoperable. Apparently not recognizing the error, the maintenance technicians had wired the new switch the same way; thus, the warning system remained inoperative.

Moreover, investigators found no record of compliance with an airworthiness bulletin requiring tests of the system every 12 months. "The [operator's] maintenance control subcontractor indicated that the requirement … had inadvertently been omitted when setting up the aircraft's maintenance database [after the King Air was registered in Australia in 2006]," the report said.

"That omission meant that a functional test of the aircraft cabin altitude warning system was not carried out on several occasions following the fitment of the replacement pressure switch."

The report also noted that the preflight test of the pressurization system prescribed by the aircraft operating manual would not have revealed the problems with the cabin altitude warning switch or the landing gear safety switch.

Key to Survival

The report cited an ATSB study of aircraft depressurization accidents and incidents that showed that "there is a high chance of surviving a pressurization system failure, provided that the failure is recognized and the corresponding emergency procedures are carried out expeditiously."[1]

Among the occurrences included in the study was a July 21, 1999, incident in which a King Air 200 pilot inadvertently turned the engine bleed air switches off while attempting to reposition the adjacent cabin vent blower switches from "HI" to "LOW" while conducting the transition checks. He subsequently did not notice the "ALT WARN" light and lost consciousness during cruise flight at FL 250. The right-seat passenger, who was an experienced pilot but not type-rated in the 200, conducted an emergency descent. The pilot regained consciousness during the descent and subsequently landed the aircraft without further incident.

The ATSB's investigation of the King Air 200 incident generated a recommendation in 2000 to require installation of aural cabin altitude warnings in King Airs and "other applicable aircraft." Although CASA initially accepted the recommendation, it eventually chose to recommend, rather than require, installation of aural warning systems.

Noting that very few operators had voluntarily installed aural warning systems, ATSB reiterated the recommendation for mandatory installation during its investigation of the C90 incident.

"Although in this instance the cabin altitude warning system did not operate, numerous studies … have shown that when affected by hypoxia, human beings respond better to an audible warning [than to a visual warning]," the report said.

"Had the [incident] aircraft been fitted with an audible warning system … that operated independently of its visual system, it is likely that, even in the high workload at the time, the pilot would have been alerted to the pressurization event well before the onset of hypoxia."

In response to the reiterated recommendation, CASA in October 2010 publicly proposed mandatory installation of aural cabin pressure warning systems in all single-pilot, turbine-powered, pressurized aircraft.

In June 2011, CASA told ATSB that it withdrew the proposal because it had met "negative response" by operators in Australia and had received no support from the U.S. Federal Aviation Administration.

The report said that although ATSB "can understand CASA's and the industry's preference to not mandate uniquely Australian requirements," the bureau "remains concerned with the continuing incidence of serious incidents and fatal accidents in which the occupants of single-pilot, turbine-powered, pressurized aircraft have been affected by, or have succumbed to, unrecognized hypoxia in an unpressurized cabin."

This article is based on ATSB Transport Safety Report AO-2009-044, "Air System Event, 74 km NE of Perth Airport, Western Australia, 16 July 2009, VH-TAM, Beechcraft King Air C90." The report, issued in September 2011, is available at <atsb.gov.au/publications/investigation_reports/2009/aair/ao-2009-044.aspx>.

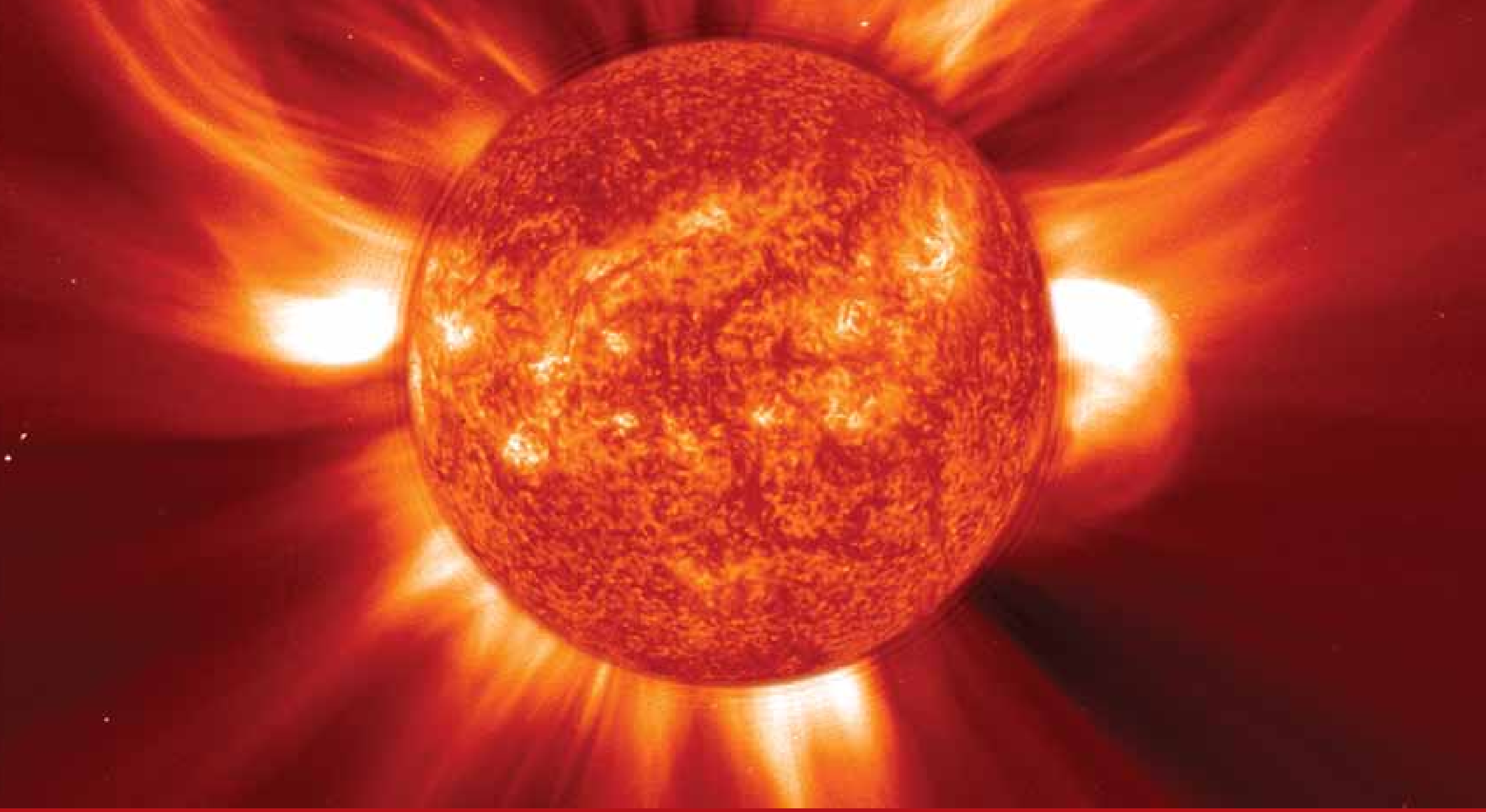
Note

1. The study report, *Depressurisation Accidents and Incidents Involving Australian Civil Aircraft 1 January 1975 to 31 March 2006*, is available at <atsb.gov.au/media/32876/b20060142.pdf>.

BY WAYNE ROSENKRANS

Everyone's Business

Polar route operators routinely adapt to space weather, but scientists envision global communication interference and electrical blackouts.



European Space Agency and U.S. National Aeronautics and Space Administration — Solar and Heliospheric Observatory (SOHO)

A widely spreading coronal mass ejection (toward top of page) and multiple solar flares were digitally combined by the SOHO project from 2002 satellite images of the sun.

Maximum activity in the sun's current 11-year cycle[1] likely will occur in May 2013. By then, aircraft operators conducting flights on polar routes might not be the only aviation industry segment affected by scenarios that only recently seemed like science fiction (*ASW*, 6/07, p. 22). Space weather scientists and natural disaster specialists lately point to these flights to convince the rest of society that other solar concerns on the horizon are just as real as the threat of disrupted high-frequency (HF) radio communication.

During the third week of February 2011, airlines rerouted polar flights away from the poles to avoid the possibility of unusable HF radios, said Jane Lubchenco, undersecretary of commerce for oceans and atmosphere and administrator of the U.S. National Oceanic and Atmospheric Administration (NOAA). "That, in turn, resulted in individuals being bumped from flights and increased fuel costs because of the longer trajectories," she said. "Communication problems [also had been reported by flight crews in 2010] on flights from Hawaii to Southern California, and [a solar] flare also disrupted communications in parts of the Western Pacific Region, as well as in Asia. So this [so-called Valentine's Day 2011 geomagnetic] storm simply reinforced the fact that space weather is a serious concern and that we must continue to support the space weather observations and modeling tools to predict what might be coming our way."

The airlines flying from the United States to Asia in February had been forced to detour to the south over Alaska, added Thomas Bogdan, director of the NOAA Space Weather Prediction Center. "This unusual [rerouting] was in response to space weather," he said.

Lubchenco and Bogdan spoke during the Annual Meeting of the American Association for the Advancement of Science in Washington at a public symposium[2] titled "Space Weather: The Next Big Solar Storm Could Be a Global Katrina."

When the peak number of solar flares occurred in April 2000, tagged as the solar maximum of the last solar cycle, human reliance on technologies such as ultra-long-range airline travel and wireless smartphones was relatively new. "Many fewer aircraft were flying polar flights [then] just because of the long distances involved," Lubchenco said. "Space weather is certainly becoming more front-and-center as the threats to our critical infrastructure are realized. As we approach the solar maximum, it seems pretty clear that we are going to be looking at the possibility of not only more solar events, but … some very strong events. … So I suggest that space weather should be everyone's business."

Out of This World

Space weather "refers to the conditions on the sun and in the solar wind, magnetosphere, ionosphere and thermosphere that can influence the performance and the reliability of space-borne and ground-based technological systems and endanger human life or health," said Juha-Pekka Luntama, program coordinator for space situational awareness, European Space Agency. Bogdan offered a briefer definition: "Energetic particles and radiation masses of magnetized plasma that come from the sun and impact us here on Earth."

Periodically, at some locations on the sun, its magnetic field "gets entangled and keeps twisting and twisting, further and further, until something breaks … and then we have [an extremely high] release of energy," Luntama said. Each of the resultant solar flares appears as a flash of light in videos and pictures taken by cameras aboard solar-imaging satellites <www.swpc.noaa.gov>. At these moments, the sun often releases ultraviolet (UV) radiation, extreme UV radiation and X-rays toward Earth, and they interact with Earth's ionosphere, causing various effects.

"Sometimes, solar flares are associated with a release of the matter of the sun itself into space — as a vast cloud of plasma [called a coronal mass ejection (CME)]," Luntama said. "When this plasma interacts with the magnetic field protecting Earth … very complex physical events [such as the aurora typically seen in polar regions] take place … and also rare events that can be very harmful. … When a CME takes place [and] if the conditions are just right, this plasma can enter inside the magnetosphere of Earth. The CME creates … geomagnetically induced currents [GICs in electric] power grids that can cause damage to transformers and cause blackouts."

The Valentine's Day geomagnetic storm unfolded in a typical way. One bright spot on the sun began Feb. 12 to produce M-class solar flares, those in the middle of the strength scale. "[Space weather prediction centers] sent messages that [this class of] solar flare had taken place … nothing extraordinary … nothing to seriously worry about — just be aware," Luntama said. On Feb. 13, worldwide subscribers to space weather alerts — widely available to the public, including as free and paid smartphone applications — learned that the solar flare involved a CME and were encouraged to monitor all further messages about this solar activity.

If any CME is visible from Earth, it very likely will strike the Earth's magnetosphere, he said. On Feb. 14, an X-class solar flare — a classification for very strong types — occurred, something scientists had not observed since December 2006. By Feb. 17, possible outcomes on Earth "began to get a bit more interesting," he recalled.

"X-ray peaks in observations from [U.S. Geostationary Operational Environmental Satellites were] the message that really woke us up," Luntama said. "They meant that a very powerful solar flare actually had ejected coronal mass towards us. We could not tell at this point what was going to happen because … we did not know [the determining factor —] the orientation of the magnetic field of the sun in [relation] to the magnetic field of Earth. … If the magnetic fields are parallel, then we are well protected, our 'shields are up' [— that is,] the particles would have a very hard time penetrating inside the magnetic field of Earth. If magnetic fields are pointing in the opposite direction … then we have a potential danger. … It turned out that we were quite well protected this time. … Effects were very minor."

Radiation from solar flares moves from the sun to Earth at the speed of light — a distance of 93 million miles [150 million km] — in about eight minutes and also signals the departure of coronal plasma if a CME is involved, NOAA's Bogdan said. Plasma from

CMEs, however, takes longer to reach Earth — typically several days. In the fastest known time, for an 1859 geomagnetic storm called the Carrington Event, plasma arrived at Earth in 17 to 18 hours. By comparison, the Valentine's Day event plasma reached Earth about three days after the associated solar flares were detected.

Swedish Lessons

Helena Lindberg, director general of the Swedish Civil Contingencies Agency (MSP), said that potential hardships of coping with a worst-case geomagnetic storm should be easy to imagine for anyone on Earth. "The harsh winter [of 2010–2011 that the United States and Europe] experienced has been a forceful reminder of how difficult it would be to have a massive electrical failure in prolonged cold weather," Lindberg said. "In the whole range of serious second-order and third-order consequences [after the first few hours] — with basic infrastructure being wiped out for an extended period of time — [we would not be] talking about days or weeks but several months without electric power, blackouts across large regions of Europe and the United States, the flows of essential goods and information disrupted. … Many of my European Union colleagues … still need to be convinced that space weather is just as important as normal weather."

The latitude of a country and its history can be highly influential in focusing public attention and encouraging government and private sector preparations for space weather mitigation, she added. "In 2003, during [a geomagnetic storm called the] Halloween Event, Sweden suffered from rather serious problems with power outages affecting a large area of the southern part of Sweden," Lindberg recalled. "Thanks to timely alerts and warnings from the Swedish Space Weather Prediction Center [and to the planned resilience of our power grid], the damage could be controlled. … To cope with the vulnerability of long transmission flows [for many north-south power lines], we had created a national grid protected by a high number of capacitors."

The latest Swedish goal for the power grid is design, configuration and manufacture of new transformers that will withstand GICs. Another of the country's highest space weather–related priorities, based on risk and vulnerability analyses so far, is fully understanding the interdependencies among its infrastructure components, she said.

The aviation industry, like the public at large, needs to understand the difference between brief disruptions of an operational service, perhaps lasting one or two days, that are already familiar to them and a worst-case geomagnetic storm that could damage physical infrastructure of telecommunications networks and power grids, some speakers said.

"If transformers burn and blow because of GICs, or if satellites are damaged because they are not shielded well enough, [these are things we] can't easily replace," said Stephan Lechner, director of the European Commission's Joint Research Centre Institute for the Protection and Security of the Citizen (JRC). "If many transformers in the Northern Hemisphere blew simultaneously, there would not be enough spare [backup transformer] capacity just to deliver spares everywhere — [replacement] could take literally years. That worst-case scenario would involve prolonged power outages while waiting for transformer replacement."

Lindberg added that studies have estimated that some countries could take four years to fully restore power grids, and five years to replace satellites for which spares do not exist. "So consider being without power for four years; in certain areas, that might constitute a severe problem," she said. "That is the worst-case scenario."

Restoring Network Operations

Worst-case space weather like the Carrington Event could cause significant damage and disruption if network and power grid weaknesses have not been mitigated, said Lechner. "The basic idea of shielding … would not work very nicely with large infrastructures … in our modern world," he said. Rather, by focusing on control centers that protect intelligent networks and power grids, "we [could plan] for a reconfiguration of the infrastructures," he said. "If we have to react to space weather in a hurry … we might even consider [preemptively] a partial infrastructure reconfiguration or shutdown."

A geomagnetic storm–induced disruption of global positioning system (GPS) timing signal receivers in telecommunication networks can be mitigated by a backup system such as local atomic clocks. However, network operators would not get email warnings if the synchronized time already had been lost. "If there is a bad space weather event — we have an outage for say, half a day, one day, two days — [operators would expect to exchange] quite a lot of emails," he said, noting that a network resynchronization typically requires at least 24 hours.

Another difficulty is reaching consensus about how nations should respond, implement common practices, establish requirements and assign responsibilities to the private sector. "In Europe alone, with more than 200 telecommunication network operators,

'Valentine's Day' Geomagnetic Storm of 2011

Wednesday, Feb. 9 — Four, that's right, four new active regions popped up on the sun yesterday. … Region 11153 … remains poised with the potential to produce some large solar flares.

Friday, Feb. 11 — Old Region 11149 is just beginning to reappear, having transited the far side of the sun. During that transit, multiple coronal mass ejections [CMEs] were observed that were directed away from Earth.

Monday, Feb. 14, Valentine's Day — The largest X-ray flare in over one year occurred yesterday at 1737 [Coordinated Universal Time (UTC)]. Region 1158 produced the impulsive R2 [class] (moderate) X-ray burst, part of the full eruption that also included a faint, Earth-directed CME plus radio bursts across the spectrum.

Tuesday, Feb. 15 — The hits just keep on coming! Region 1158 produced the largest X-ray flare in more than four years, an X2.2 [class], earlier today at 0156 UTC, reaching the R3 (strong) [U.S. National Oceanic and Atmospheric Administration (NOAA) Space Weather Scales] level.

Wednesday, Feb. 16 — The calm before the storm. Three CMEs are en route, all a part of the [high frequency] radio blackout events on Feb. 13, 14 and 15 (UTC).

Thursday, Feb. 17 — The first interplanetary shock, driven by the CME from Sunday, is expected [at Earth] any time. Soon thereafter, the shock from Monday evening's R3/CME is due. Look for G1–G2 [class geomagnetic storms] (and maybe periods of G3 [geomagnetic storms] if the following shock compresses and enhances the CME magnetic field).

Friday, Feb. 18 — A G1 [class] (minor) geomagnetic storm continues. … A long-awaited interplanetary shock, perhaps one of an ensemble of shocks, passed the ACE spacecraft [Advanced Composition Explorer satellite monitoring the solar wind at] about 0045 UTC.

Saturday, Feb. 19 — The geomagnetic storm has ended. The observations of the CMEs and the models of this solar eruption were unprecedented.

This narrative was excerpted from day-by-day Web site reports by the NOAA Space Weather Prediction Center in Boulder, Colorado, U.S. <www.swpc.noaa.gov>.

the standards only tell them what accuracy of timing [is required] but not how to do it," Lechner said. "So they could [synchronize] timing only based on GPS or without GPS. Nothing is standardized."

These network operators in Europe received a January 2011 JRC survey of existing equipment and space weather contingency planning. As of the symposium, a small number had responded to the survey, and some of their engineers said they were entirely dependent on GPS time references. They estimated that disruptions to accurate time signal sources caused by geomagnetic storm–induced effects would require two to four weeks to fully resume normal operations, he said.

Today's Readiness

Sir John Beddington, chief scientist and adviser to the prime minister of the United Kingdom, voiced concern about any scientific, engineering or governmental work on space weather mitigation that assumes specific levels of infrastructure vulnerability with "absolutely no empirical testing."

"Space weather is so serious that we don't want to learn by our experience of it," he said. "It is slightly scary and properly so — we have got to be slightly scared by these events; otherwise, we will not take them seriously, and then they will surprise us."

National industry sectors such as commercial air transport require the most accurate predictions possible of space weather timing and effects, and consensus about which worst-case scenario should be the basis of affordable emergency planning. "Our civil contingency group is characterizing what we would term a 'reasonable worst-case,'" Beddington said. "Everybody knows about the Carrington Event, [but] was that the reasonable worst-case that we need to [use in] our contingency planning?" Carrington involved "a conjunction of relatively low-probability factors and was far off the scale … so we haven't decided," he said.

When the next solar maximum occurs around 2025, societies on Earth likely will be even more "electronically vulnerable" than in 2011 unless they have prepared adequately, the JRC's Lechner said, adding, "We have lead time for that."

Notes

1. Solar cycles have a variable length. The shortest recorded in recent centuries have lasted about nine years and the longest have lasted 14 years.
2. The February 2011 symposium was organized by NOAA and the JRC. Presenters and panelists represented the European Space Agency, JRC, NOAA, MSP and the U.K. Government Office of Science.

On Jan. 8, 1989, a British Midland Boeing 737-400 left London Heathrow Airport for Belfast, Northern Ireland, with eight crewmembers and 118 passengers. About 15 minutes into the flight, as the aircraft was climbing through 28,300 ft, a series of compressor stalls occurred in the left engine as a result of a fan blade detachment. Passengers and cabin crew heard an unusual noise, accompanied by moderate to severe vibration; some of those in the airplane were aware of smoke and a burning smell in the cabin, and many saw signs of distress from the left engine, which they described variously as fire, torching or sparks.[1]

On the flight deck, the pilots followed an emergency drill that led them to believe that the right engine had suffered damage. They reduced power and then shut down the healthy right engine without seeking observations from the cabin crew. The captain announced over the public address system that there was trouble with the right engine, that the engine was now shut down and that they were diverting to East Midlands Airport.

Although some passengers and cabin crew were puzzled by the announcement referring to the right engine, no attempt was made to inform the pilots that they had witnessed problems with the left engine. With little thrust available, the aircraft struck a field on final approach to the airport, with 48 fatalities.

Over the past 20 years, numerous dramatic accidents and incidents have highlighted the dangers of inadequate cockpit-cabin coordination and communication. The critical question raised at all the subsequent investigations was why this occurred, and what measures could be put in place to prevent it happening in the future.

More Than A DOOR

Despite years of CRM training, barriers still inhibit cockpit-cabin information flows.

BY JAMIE CROSS

The barriers to this communication can be traced to the earliest days of commercial aviation, when the captain was considered to be the ultimate authority. Little input from the other pilots was requested or considered, and there certainly was no input from the cabin crew.

However, this lack of synergy became increasingly recognized to have played a role in many accidents; initial attempts to improve the flow of information focused on the cockpit.

Meanwhile, in the cabin, airlines were introducing training that enabled cabin crew to work more effectively together. One accident highlighting this need occurred on Dec. 20, 1995, when a Tower Air Boeing 747, attempting to take off from New York John F. Kennedy International Airport during a snowstorm, departed the left side of the runway. A lack of coordination and communication in the cabin contributed to a flight attendant suffering serious injuries from an incorrectly stowed galley cart and to minor injuries to 24 passengers. Subsequent recommendations from the U.S. National Transportation Safety Board said the U.S. Federal Aviation Administration should work to improve communications among cabin crew and "encourage the use of this accident as a case study for crew resource management."[2]

Yet, despite this training, the separate entities still did not communicate effectively. It took years for the training to include the cabin crew, and then to evolve into what is now known as crew resource management (CRM), first achieved by America West Airlines' approach to CRM, titled "Aircrew Team Dynamics."[3]

However, despite this new CRM training, gaps remained. Some of these accidents and incidents are attributable to a misunderstanding, or misinterpretation, of the sterile cockpit rule, enacted in the United States in 1981 to help curb accidents in which the flight crew was diverted from the task at hand during critical phases of flight.

Shortly after takeoff on July 9, 1995, from O'Hare International Airport, Chicago, an ATR 72 operated by Simmons Airlines experienced the loss of the rear cabin entry door at an altitude of 600 feet.[4] A flight attendant could hear air coming through the door prior to the door's separation but did not call the cockpit because the aircraft was under sterile cockpit conditions. When asked later under what conditions she would call a sterile cockpit, she responded that she would call in case of fire or a problem passenger.

Studies undertaken in the mid-1990s further accentuated the importance of joint pilot and cabin crew training, and joint pilot and cabin crew preflight briefings.[5] Despite these advances, accidents and incidents continued. For example, aircraft on rare occasions land in the wrong place. Real-time moving maps in the cabin give cabin crew and passengers awareness of their position, yet nothing was said on Sept. 5, 1995, when a Northwest Airlines McDonnell Douglas DC-10 bound for Frankfurt, Germany, mistakenly landed in Brussels, Belgium, about 200 mi (322 km) away.[6] Passengers and cabin crewmembers were disturbed by the change in the flight plan but did not attempt to contact the pilots. Some cabin crewmembers even speculated that the aircraft had been hijacked, but contact still was not made with the pilots. When it became apparent the aircraft was landing at the wrong airport, they were reluctant to contact the pilots because of the sterile cockpit rule.

Another example of barriers to communication are flight deck doors, which create a physical barrier; following the Sept. 11 terrorist attacks, they were required to be locked prior to engine start-up. On Jan. 11, 2006, an Avro 146-RJ100 suffered a jet-pipe fire on engine startup at Edinburgh Airport, Scotland.[7] The fire knocked a generator off-line, severely restricting the interphone system. The cabin crew could not establish communication with the pilots, and were unable to open the locked cockpit door. The pilots were only made aware of the fire when it was reported to them by a ground handler. The cabin crew initiated an emergency evacuation of the passengers, of which the flight crew was unaware.

The author conducted a study to ascertain why communication breakdowns still play a role in accidents. A 26-item Web-based questionnaire was constructed for cabin crew. The questionnaire captured basic demographic information, work experience, seniority, aircraft

Yet, despite this training, the separate entities still did not communicate effectively.

types flown, exposure to training and experience of preflight briefings. There was also a series of questions that described scenarios to help us understand how cabin crewmembers would react in certain situations, gauging their reluctance to pass information to the pilots, their ability to prioritize information, their understanding of the impact of physical separation, their familiarity with technical and operational terminology, and their general awareness of the flight environment with regard to safety. Some of these questions were duplicated from previous research to allow a direct comparison of "now" and "then." Others were drawn from actual accident investigation reports. Mixed in with these historical scenarios were fabricated scenarios of less importance to present the participant with a choice. For example, do you tell the pilot there's a fire — a real scenario extracted from an accident report — or do you tell the pilot that there's no milk aboard?

The study discussed 19 accidents and incidents related to a breakdown of communication; the sample size was 263.

The study found that, as a result of the CRM training, cabin crews' working practices are safer today. This was based on improvements in all areas studied when measured against previous research, a positive behavioral trend in realistic scenario analysis compared with actual accidents, and a wide implementation of recommendations made by accident investigators in those actual accidents.

It also found a significant increase in the amount of joint CRM training with pilots (Table 1), although this still does not occur as often as might seem appropriate.

The study found that the majority of cabin crew could correctly distinguish between emergency and non-emergency events (Table 2). However, there continued to be confusion over the sterile cockpit rule, resulting in flight attendants saying they would contact the pilots with trivial and non-emergency information during critical phases of flight. Similarly, it was found that vital information would not be relayed to the pilots for fear of infringing upon the rule, even during non-critical phases of flight. With 96 percent of participants indicating that they have had some form of CRM training, a discussion of the sterile cockpit rule clearly is not being included, or it is being presented ambiguously, in this training.

Which statement best describes your experience of Crew Resource Management (CRM) training?

Answer Options	Response Percent	Response Count
I do not know what CRM training is	0.9%	2
I have never had CRM training	2.7%	6
I had CRM training once at the beginning of the job and it was also attended by pilots	6.4%	14
I had CRM training once at the beginning of the job and there were no pilots in present	11.9%	26
I have CRM training on a regular basis (at least annually) and it was also attended by pilots	65.3%	143
I have CRM training on a regular basis (at least annually) but it was rarely/never attended pilots	12.8%	28

Source: Jamie Cross

Table 1

The ability to understand technical aspects of a flight, and therefore to correctly relay relevant information to the pilots should an unusual situation occur, has an impact on the communication process. If the pilots do not expect reliable information from the cabin crew, they may be more skeptical about the information they do receive and more hesitant to utilize cabin crewmembers as a source of information. Similarly, a flight attendant who is not comfortable with their own technical knowledge may be less willing to pass information forward to the pilots. The study found that there is a significant improvement in the confidence of flight attendants to describe technical components or malfunctions of an aircraft.

While this study found that the frequency of preflight briefings has increased over previous research, they are not occurring prior to every flight, as might be desired. Crews may be unfamiliar with each other, and, in some unusual situations, may even come from different departments with different standard operating procedures and will be physically separated once on board, all of which makes communication difficult. One respondent to the questionnaire stated that a locked flight deck door "has undone 15 years of excellent CRM." Unless there is good rapport between pilots and cabin crew, established predominantly through preflight briefings, this physical separation can lead to feelings of alienation among cabin crewmembers and hesitation to contact the pilots.

Finally, the study addressed whether the accidents and incidents explored might have been prevented. With

You have completed your emergency demonstration and the aircraft is being pushed back from the stand. What is the earliest time you would contact the pilots given the following situations:

Answer Options	Immediately (5)	During Taxi (4)	During Climb (3)	In the Cruise (above 10,000 feet) (2)	Never (1)	Rating Average
To discuss the crew meals	2	0	4	146	29	1.90
In the event of what would appear to be smoke in the cabin	172	2	5	1	1	4.90
In the event of a disruptive passenger that does not immediately endanger safety	45	56	4	64	12	3.32
In the event of a disruptive passenger that is endangering safety	161	8	3	8	1	4.77
To discuss en-route weather	1	4	5	136	35	1.90
In the event of you hearing an unusual gentle humming noise coming from a door after take off, which progressively gets louder	68	5	67	40	1	3.55

Note: The answer options were rated as to how quickly the crewmember would contact the pilots, with 5 being the most rapid response and 1 being the least rapid response to arrive at the rating average listed.

Source: Jamie Cross

Table 2

reference to the British Midland accident, the evidence suggested a high probability that if the pilots of the ill-fated aircraft had received more information from the cabin crew, they might have had time to avert the accident.

In terms of future work, the breakdown of communication should continue to be monitored, since it is still, in part, a key element in many accidents and incidents. In addition, a study focusing on pilots would be beneficial.

Among many recommendations, the study included these:

All cabin crew should have initial CRM training, followed by refresher sessions, containing an element in which it is combined with pilot CRM training.

Included in any cabin crew CRM training should be a clear, concise and practical interpretation of the sterile cockpit rule.

In addition to CRM training, cabin crew would clearly benefit from a threat and error management program.

Every flight should be preceded with a briefing attended by all pilots and cabin crew, in a relaxed, informal atmosphere, inviting cabin crew participation and introductions.

Cabin crew should be made aware of, and encouraged to use, voluntary safety reporting systems.

All cabin crew should have technical and operational training.

Aircraft public address systems should be improved, or another system installed, such as the use of personal ear pieces, to ensure that the cabin crew can always hear pilot announcements.

Jamie Cross is a master's degree graduate in air transport management from Cranfield University, U.K., currently working as an aviation analyst and ground school lecturer.

Notes

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BY RICK DARBY

Zero Gained

Taiwan's commercial transport category airplanes have had no fatal accidents since 2002.

Taiwan's civil aviation accident record for transport category airplanes over the 2000–2009 period shows a single fatal accident each in the commercial jet and turboprop categories. Of 34 occurrences[1] — accidents and incidents — during the 10 years, the largest number happened in the landing phase of flight. But the two occurrences in the most serious class took place en route. The data were released in a report by the Taiwan Aviation Safety Council (ASC), the official accident investigation body.[2]

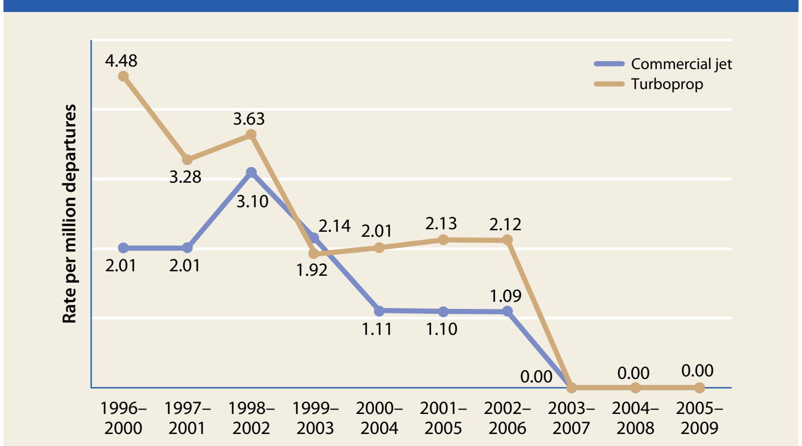
The fatal accident in commercial jet operations was in 2002, and the 2000–2009 fatal accident rate was 0.61 per million departures. For turboprops, the fatal accident also occurred in 2002, and the 10-year fatal accident rate was 1.02 per million departures.[3]

Based on five-year moving averages[4] going back to 1996, the fatal accident rate per million departures has shown improvement except for a spike in the 1998–2002 period (Figure 1). Before 2003–2007, the rates for turboprops were almost always higher than for commercial jets. From then on, the moving average has held steady at 0.0 for both airplane classifications.

The ASC also calculated hull loss occurrence five-year moving averages. In contrast with fatal occurrences, the hull loss rates for commercial jets were higher than for turboprops beginning with 1999–2003. "The difference suggested that there were some cases where commercial jet airplanes' … occurrences resulted in hull loss, but without fatalities," the report says. In 2009, turboprops completed their third straight five-year period with a moving average of zero hull losses.

According to the accident definition of the International Civil Aviation Organization (ICAO), there were 16 transport category

Taiwan Fatal Occurrence Rates, by Million Departures, 2000–2009



Note: Data points represent five-year moving averages.

Source: Taiwan Aviation Safety Council

Figure 1

airplane accidents in Taiwan over 10 years (Figure 2). Of the total, 13 involved commercial jets, and three involved turboprops. The 10-year rate was 6.1 accidents per million departures.

"Most of the occurrences during [the 2000–2009] period resulted in serious injuries without aircraft damage [or] substantial damage only," the report says, with those two categories accounting for 12 of the 16 accidents.

The ASC devised its own classifications for occurrences because, the report says, "accidents as defined by ICAO might be classified into [the] same category with significantly different levels of severity."

The ASC placed each occurrence into one of six classes. Those concerning transport category airplanes include the following:

- Class I: "An occurrence of an airplane not of a general aviation nature, which resulted in fatality or injury and the airplane was substantially damaged."
- Class II: "An occurrence of an airplane not of a general aviation nature, which resulted in fatality or injury but the aircraft was not substantially damaged."
- Class III: "An occurrence of an airplane not of a general aviation nature, which did not result in fatality or injury but resulted in substantial damage to the aircraft."
- Class V: "Serious incidents of all types of aircraft except ultralight vehicles."[5]

Commercial transport category jets had, over the 10-year period, a rate of 0.20 occurrences per million flight hours for class I, 1.19 for both class II and class III and 2.78 for class V. There was a single occurrence in class I, six each in class II and class III, and 14 in class V.

Comparable figures for commercial transport category turboprops during the 10-year stretch were 1.09 occurrences per million flight hours for class I, 0.00 for class II, 2.18 for class III and 4.35 for class V.

Overall, for 2000–2009, the class I occurrence rate for turboprops was 5.5 times that for jets.

Taiwan Accidents, Transport Category Airplanes, by Phase of Flight, 2000–2009

Note: Accident definitions match those of the International Civil Aviation Organization.

Source: Taiwan Aviation Safety Council

Figure 2

Five-year moving average rates for class I occurrences decreased over the years 2000–2006 for transport category airplanes, based on occurrences per million flight hours. "The moving average for class I occurrences decreased year over year since 2002 and achieved the zero-accident rate per million hours flown by 2007," the report says. "The numbers of class II occurrences had always been low until an increasing trend began in 2005. In 2005, there were two occurrences of clear air turbulence resulting in injuries and in 2006 there was a midair collision, together causing the upward trend. The trend continued to 2008 because of two occurrences related to turbulence.

"The trend for occurrences in class III increased gradually over the years and did not seem to go down significantly in the recent five years. For occurrences in class V, the occurrence was at its highest in 2003, resulting in 4.2 per million flight hours, but the rate gradually decreased to 1.81 per million flight hours and remained [near that level] to 2009."

In terms of occurrences per million departures, the trend was nearly the same (Figure 3, p. 50).

The report added the proviso, however, that "prior to 1998, documented statistics were limited, only aviation accidents would be recorded and serious incidents were not officially recorded. … Therefore, the average occurrence rate in class V was more reliable since the interval of 1999–2003."

In total, for the 2000–2009 years, class I occurrences were 6 percent of the total, class II 18 percent, class III 23 percent and class V 53 percent.

The ASC looked at the 34 occurrences according to phase of flight as defined by the U.S. Commercial Aviation Safety Team (CAST)-ICAO (Figure 4). Fifteen, or 44 percent, took place during the landing phase. Eight were en route, including two class I, five class II and one class V occurrences.

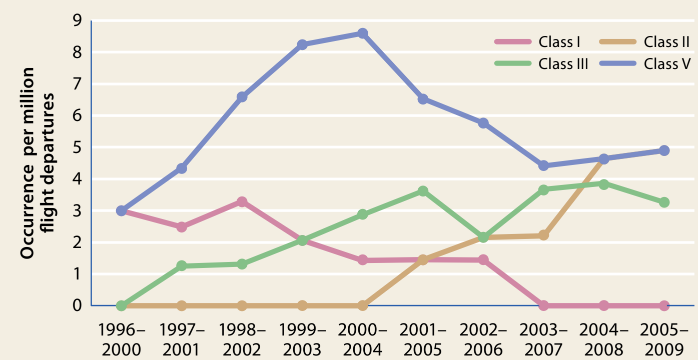
Occurrences were categorized according to CAST-ICAO taxonomy (Figure 5).[6] Runway excursions were the most frequent, totaling nine, or slightly above one-quarter of the total. Next most common were the five instances of abnormal runway contact, 15 percent of all the occurrences.

The report says, "When further analyzed [by] ASC classification, the most frequent class I occurrences were SCE-NP [system/component failure or malfunction, non-powerplant] and ICE [icing]. Although the highest numbers of occurrences came from the category of RE [runway excursions], eight of the nine cases were class V."

Following what it says is U.S. National Transportation Safety Board practice, the ASC sliced the data yet a third way, using the broad categories of personnel, environment and aircraft.[7] Among the 34 occurrences, the investigations of 29 had reached closure. At least one of the broad categories was implicated in each, and in some cases, more than one was cited.

"For most of the 10-year period, personnel were cited as a cause or factor in 89.7 percent [of occurrences], followed by 34.5 percent of environment-related causes/factors and by 17.2 percent of aircraft-related causes/factors. … The pilot was responsible in 62.1 percent of occurrences where personnel was the cause or factor."

Taiwan Occurrence Rates, Transport Category Airplanes, by Class, 2000–2009

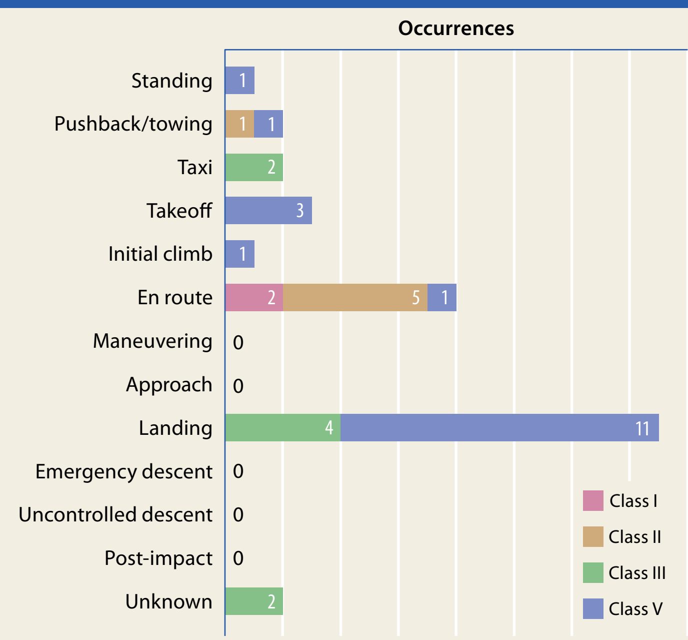


Note: Data points represent five-year moving averages. Classes are determined by the Taiwan Aviation Safety Council. For definitions, see p. 49.

Source: Taiwan Aviation Safety Council

Figure 3

Taiwan Occurrences, Transport Category Jet and Turboprop Airplanes, by Phase of Flight, 2000–2009



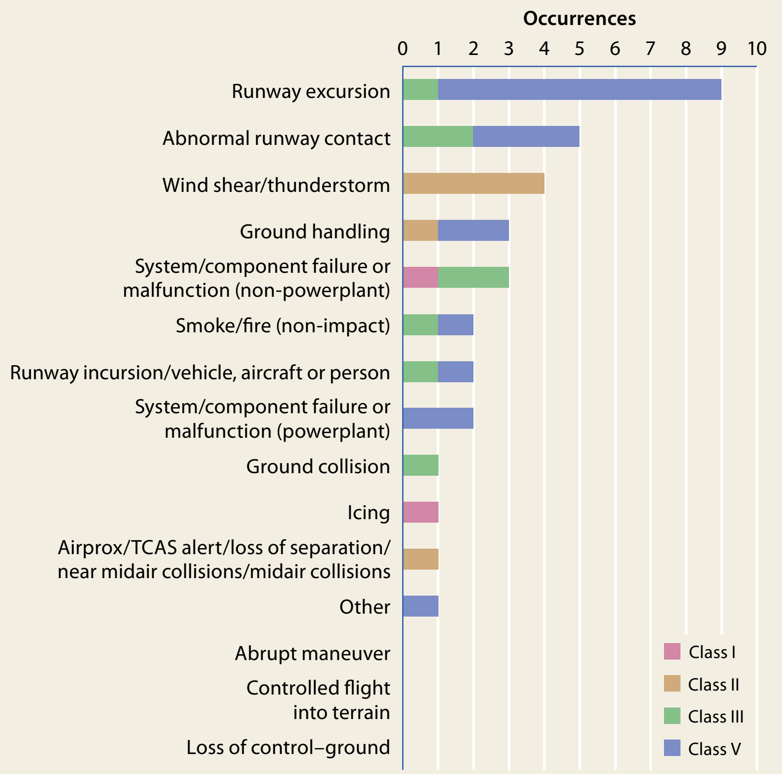
Note: Phases of flight match U.S. Commercial Aviation Safety Team–International Civil Aviation Organization definitions. Classes are determined by the Taiwan Aviation Safety Council. For definitions, see p. 49.

Source: Taiwan Aviation Safety Council

Figure 4

Pilot, other personnel, weather and structure were each cited in 3.4 percent of class I occurrences involving transport category airplanes.

Taiwan Occurrences, Transport Category Airplanes, by Causal Factors, 2000–2009



TCAS = Traffic-alert and collision avoidance system

Note: Phases of flight match U.S. Commercial Aviation Safety Team–International Civil Aviation Organization definitions. Classes are determined by the Taiwan Aviation Safety Council. For definitions, see p. 49.

Source: Taiwan Aviation Safety Council

Figure 5

Among all occurrences, pilots were a cause or factor in 62 percent. Weather was a cause or factor in 30.9 percent of occurrences.

The report combines data for general aviation (GA) and helicopters, while noting that in Taiwan, "the majority of [GA] is carried out by helicopter, with the exception of a few turboprop airplanes." GA includes "service aircraft (fixed-wing and rotor aircraft) and helicopters (transport category)."

Over the 2000–2009 period, there were two fatal GA/helicopter accidents and an overall accident rate of 8.96 per 100,000 flight hours.

The report says that the ASC made 465 aviation safety recommendations from April 1999 to June 2010 — about half to Taiwanese government agencies, a third to the aviation industry and the rest to non-Taiwanese organizations. Of the 236 recommendations to government agencies leading to action plans, 235 have been accepted, the report says.

Notes

1. The ASC defines an *occurrence* as "associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which: (1) a person sustains death or serious injuries; (2) the aircraft sustains substantial damage or [is] missing; or (3) death or serious injuries of a person or substantial damage of the aircraft nearly occurred."

   This differs from the ICAO definition of an *accident*, which adds, "Death or serious injury results from being in the airplane; or direct contact with the airplane or anything attached thereto; or direct exposure to jet blast." The ICAO accident definition does not include events that "nearly occurred."

2. The study is available on the Internet at <www.asc.gov.tw/author_files/statistics00-09_Eng.pdf>. Sources of the ASC data include the Taiwan Civil Aeronautics Administration and the ASC's own occurrence investigation reports.

3. Turboprop airplanes for which data were included in the study were the Avions de Transport Régional ATR 72, Fokker F-50, Dornier Do-228, de Havilland DH-8 and Saab 340.

4. A moving average shows average values over a set period, in this case five years. The purpose of a moving average is to make trends clearer by smoothing out short-term fluctuations.

5. Class IV, omitted in the figures, refers to helicopters, general aviation or public aircraft.

6. A list of the categories and abbreviations is available at <www.intlaviationstandards.org/acronyms.html>.

7. "Personnel classification included pilot and other personnel such as maintenance personnel, air traffic controller and management personnel," the report says. "Environmental categories included those causes related to weather, airport facilities, air traffic facilities, time of the accident (day or night), light conditions and terrain conditions. In the category of aircraft-related causes or factors were failures of aircraft systems and equipment, engines and structure or performance of the aircraft."

The Restless Flight Attendant

A statistical analysis finds more detail about flight attendants' reports of on-the-job fatigue.

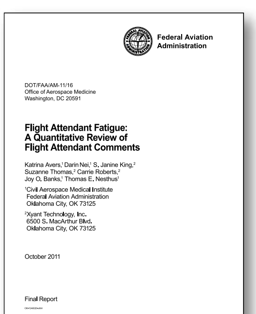
BY RICK DARBY

REPORTS

'A Significant Issue'

Flight Attendant Fatigue: A Quantitative Review of Flight Attendant Comments

Avers, Katrina; Nei, Darin; King, S. Janine; et al. U.S. Federal Aviation Administration Civil Aerospace Medical Institute (CAMI). Report no. DOT/FAA/AM-11/16. 23 pp. October 2011. Available on the Internet at <www.faa.gov/library/reports/medical/oamtechreports/2010s/media/201116.pdf>.


Federal Aviation Administration

DOT/FAA/AM-11/16
Office of Aerospace Medicine
Washington, DC 20591

Flight Attendant Fatigue: A Quantitative Review of Flight Attendant Comments

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October 2011

Final Report

Fatigue has emerged as an important safety issue among airplane crews, including cabin crewmembers, who are the "last line of defense" in some accident scenarios.

In 2005, at the direction of the U.S. Congress, CAMI partnered with the National Aeronautics and Space Administration Ames Research Center's Fatigue Countermeasures Group to review research literature and examine typical flight attendant schedules to assess whether schedules might encourage performance-undermining fatigue. That study's report concluded that "some degree of fatigue-related performance decrements were likely under the current regulations and suggested six areas of research that would facilitate understanding and government-industry decision making." It offered recommendations in six areas.

Congress then asked CAMI to conduct follow-up studies in each research recommendation area. The first area involved conducting a survey of field operations — that is, what flight attendants said about their working conditions (see *ASW*, 10/10, p. 52, for the methodology employed); the findings were published in a second report. This latest report analyzes the flight attendants' comments quantitatively.

"Overall, responses to the survey indicated that flight attendants consider fatigue to be a significant issue," this report says. "According to reports from the surveyed flight attendants, most have experienced fatigue while at work and agree that it is both a common experience and a safety risk."

For the content analysis, researchers subdivided the survey responses into eight broad categories: scheduling, health, airline and airline policy, job performance and satisfaction, meals, comments about the survey itself, workload, and break facilities. The 1,933 paper surveys and 1,506 online surveys that included comments were reduced to a more manageable number. "To ensure the sample of comments was representative of the overall general survey respondents, two demographic items [qualified] eligible surveys: (1) type of operation (low-cost, regional, network), and (2) flight attendant seniority level (junior, mid, senior)," the report says. "Two hundred surveys were randomly selected for each of the specified survey classifications, and selections were balanced by method of survey completion: 52 percent paper, 48 percent online. A total of 1,800 surveys were then content-coded."

The report says that scheduling was the most frequent broad category for flight attendant comments in the coded sample, with 79 percent mentioning it as an issue. Other frequently mentioned broad categories were health, 61 percent; job performance satisfaction, 36 percent; and airline and airline policy, 33 percent.

The issues mentioned most frequently across the three airline types and three seniority grades were "fatigue/exhaustion," in 45 percent of surveys; "rest period too short," in 40 percent; and "duty day too long," in 32 percent. Almost none of the surveys identified as issues "adequate amount of sleep," "satisfaction with benefits" and "good quality of food available."

In the broad category of scheduling, after performing a chi-square analysis for statistical significance, the researchers found no difference across type of operation and seniority for the number of comments about "rest period too short," "inconsistent or early reports" [i.e., reporting times for duty]" and "impact of delays not considered." In contrast, "duty day too long" was reported less often by junior-level flight attendants in all types of operation. "Transportation to/from rest accommodations should not be included in rest period" was mentioned most often by regional flight attendants, while network [national or international airline] flight attendants were less concerned about the issue.

"Flight attendants discussed excessive length of the duty day and indicated that the minimum rest period should be lengthened," the report says. "Some suggested the rest period should be 12 or 14 hours, while others proposed that rest periods should equal or exceed the length of the previous and/or following duty day. For example, one flight attendant said, 'Layover rest periods or scheduled rest periods should never be shorter than the longest duty day.' Flight attendants reported that the activities required during the designated rest periods significantly reduced the amount of time available for actual rest or sleep."

The second most commonly cited broad category was health, and the most commonly cited issues were "fatigued/exhausted," "inadequate amount of sleep/rest" and "physical health suffers due to job."

"Flight attendants across type of operation and seniority level were concerned with fatigue/exhaustion and the lack of sleep/rest they are routinely able to get," the report says. "On the other hand, a significant difference between type of operation was detected for 'physical health suffers due to job,' such that network flight attendants as a group had more comments regarding their physical health suffering than either low-cost or regional flight attendants."

The third most commonly cited broad category was job performance and satisfaction. Most commonly cited issues were "fatigue impact on safety/job performance" and "dissatisfaction with pay/pay for time worked." There were no significant differences in frequency of these comments across type of operation or seniority level.

"Many flight attendants expressed concern regarding their ability to do their job safely under current operational schedules," the report says. "Some discussed their inability to focus and remember routine tasks, the compromised quality of their performance and even their fears regarding their ability to respond appropriately in an emergency."

The most commonly cited issue concerning airline and airline policy was "dissatisfaction with airline/airline concern for flight attendant health and welfare," which the report says was found at similar levels among all groups.

The survey itself elicited comments, mainly positive. Across all groups, "flight attendants were generally appreciative of the fatigue research that was being conducted," the report says. "For instance, one flight attendant commented, 'Thank you for conducting this survey, as flight attendant health is a growing concern.'"

Scheduling was the most frequent broad category for flight attendant comments in the coded sample.

In the broad category of meals, the most common issue specified was "long periods of time without food/no time to eat/no food or water available." Such concerns were most frequently expressed by regional flight attendants, followed by those working for low-cost airlines.

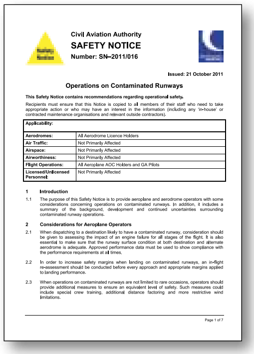
"Most comments referred to obtaining [food] or eating while on duty; however, some flight attendants indicated that finding food while on layover can be problematic due to the time of arrival and/or departure and/or the location of rest accommodations," the report says.

In summation, the report says that "overall, flight attendants considered fatigue to be a significant issue, and in fact, fatigue was the most frequently identified issue in the comments. … This is an issue that spans the various types of operations and seniority levels — it is not limited to one subset of the population."

Flight attendants from regional airlines identified three issues more frequently than those from other operational types: "too many legs/segments," food and water deprivation, and "transportation to/from rest accommodations should not be included in rest period." The report says, "Apparently, operational constraints associated with regional airlines introduced some potential fatigue issues that need to be examined. With that in mind, it should be recognized that the network flight attendants did report 'physical health suffers due to job' most frequently."

Seniority levels also created variation. "Junior-level flight attendants identified 'too many legs/segments' as an issue more frequently than senior-level flight attendants," the report says. Senior-level flight attendants reported "insufficient number of breaks/amount of time for breaks" more frequently.

"These may actually be inherently related issues that were reported simply in different terms by junior- and senior-level flight attendants," the report says. "Regardless, both of these issues appear to be of concern."



Civil Aviation Authority
SAFETY NOTICE
Number: SN–2011/016

Issued: 21 October 2011

Operations on Contaminated Runways

This Safety Notice contains recommendations regarding operational safety.

Recipients must ensure that this Notice is copied to all members of their staff who need to take appropriate action or who may have an interest in the information (including any 'in-house' or contracted maintenance organisations and relevant outside contractors).

Applicability:	
Aerodromes:	All Aerodrome Licence Holders
Air Traffic:	Not Primarily Affected
Airspace:	Not Primarily Affected
Airworthiness:	Not Primarily Affected
Flight Operations:	All Aeroplane AOC Holders and GA Pilots
Licensed/Unlicensed Personnel:	Not Primarily Affected

1 Introduction

1.1 The purpose of this Safety Notice is to provide aeroplane and aerodrome operators with some considerations concerning operations on contaminated runways. In addition, it includes a summary of the background, development and continued uncertainties surrounding contaminated runway operations.

2 Considerations for Aeroplane Operators

2.1 When dispatching to a destination likely to have a contaminated runway, consideration should be given to assessing the impact of an engine failure for all stages of the flight. It is also essential to make sure that the runway surface condition at both destination and alternate aerodrome is adequate. Approved performance data must be used to show compliance with the performance requirements at all times.

2.2 In order to increase safety margins when landing on contaminated runways, an in-flight re-assessment should be conducted before every approach and appropriate margins applied to landing performance.

2.3 When operations on contaminated runways are not limited to rare occasions, operators should provide additional measures to ensure an equivalent level of safety. Such measures could include special crew training, additional distance factoring and more restrictive wind limitations.

Page 1 of 7

SAFETY NOTICES

Due Consideration

Operations on Contaminated Runways

U.K. Civil Aviation Authority. Notice no. SN-2011/016. 7 pp. October 21, 2011. Available on the Internet at <www.caa.co.uk/docs/33/SafetyNotice2011016.pdf>.

The safety notice includes "Considerations for Airplane Operators" and "Considerations for Aerodrome Operators."

When dispatching an aircraft to a destination likely to have runway contamination, the operator should make sure runway conditions are adequate both at the destination and the alternate, the notice says. "In order to increase safety margins when landing on contaminated runways, an in-flight reassessment should be conducted before every approach, and appropriate margins applied to landing performance," it adds.

The report emphasizes the importance of flying a stabilized approach at the appropriate speed and with touchdown at the correct place. "Proper deployment of aircraft deceleration devices and correct braking technique are also critical elements to mitigating the runway-overrun risk when landing on contaminated runway," the notice says. "If it is likely that any of this may not be achieved, a missed approach may be the safest option."

For airport operators, the notice discusses various methods in use for measuring surface condition of runways and the different performance models that airplane manufacturers use to determine braking performance on contaminated runways. "Although manufacturers have used different values and models for contaminated [runway] performance, they all agree that there is no correlation between runway friction measuring devices and aircraft braking performance. For example, Airbus suggests that the only accurate method to get an accurate braking action assessment of an A340 landing at 150,000 kg [330,700 lb], 140 kt and with tire pressures of 240 psi would be for the aerodrome personnel to use a similar spare A340," adding with a touch of dry humor, "a difficult and costly exercise."

The notice says that the U.S. Federal Aviation Administration Takeoff and Landing

Performance Assessment Aviation Rulemaking Committee proposals "should aid standardized reporting and reduce subjectivity."

BOOKS

Beyond the Moral High Ground

Human Performance on the Flight Deck

Harris, Don. Farnham, Surrey, England and Burlington, Vermont, U.S.: Ashgate, 2011. 384 pp. Figures, tables, references.

Harris — managing director of HFI Solutions and a visiting professor in the School of Aeronautics and Astronautics at Shanghai Jiao Tong University, China — says that his aim in this book is to provide a "systemic overview" of human factors in piloting. "This is my attempt to try and explain what it is all about and how it all goes together. …

"Topics like error and training are all-pervasive; poor design of flight decks or procedures contributes to error; they also increase workload, which increases the likelihood of error; poor crew resource management (CRM) makes error more likely, and so on."

But the connectedness among human factors issues can create a positive knock-on effect, Harris says, not only for safety but also for airline productivity, efficiency and economy. Because there will always be a balancing act between marginal safety improvements and cost, he says, "Taking an end-to-end system perspective, good flight deck interface design simplifies operating (and hence training) requirements, making training faster and cheaper. … Simultaneously, the flight deck interfaces and better-specified training produce superior, more error-free (safer) performance. Careful selection processes may be more expensive initially but they subsequently reduce the dropout and failure rate in pilot training (which is very expensive). Analysis and modification of crew rostering practices can produce rotas [rosters] which produce more efficient utilization of flight crew, reduce crew fatigue, increase well-being and simultaneously enhance safety. … Human factors as a discipline must avoid its natural inclination to rush to claim the moral high ground by marking its territory solely within the realm of aviation safety."

The book is replete with references to research literature. Operational requirements "have been derived from the regulatory demands and from a broader need to operate safely and efficiently," Harris says. "The human factors practitioner in the aviation community is most often a user of theory rather than a generator of theory. Theory is often only generated in retrospect after the operational problem has been addressed." Still, it is not enough for front-line personnel just to know that something works; it is also necessary to know why it works, he says.

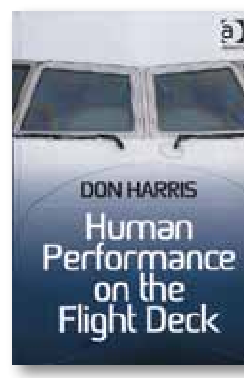
Harris takes us on an in-depth tour of the work that has been done to understand every aspect of human factors. While there is no way to avoid focusing on one subject at a time, he prefaces each chapter with a "spider web" diagram including radiating lines to show the relationship of each to the others. His discussion is divided into four parts — one more than Julius Caesar needed for all Gaul, which suggests how many elements go into a systematic study of human factors:

- "The Science Base": human information processing, workload, situation awareness, decision making, error and individual differences.

- "The (Hu)*Man*": pilot selection, training and simulation, stress, fatigue and alcohol, and environmental stressors. The term "(Hu)Man" refers to one of the factors in the so-called "five m's" system safety model, the others being physical medium, management, societal medium and machine. The (HuMan) and machine overlap to form a mission.

- "The Machine": display design, aircraft control, automation and human-computer interaction on the flight deck.

- "The Management": crew resource management and line operations safety audits, airline safety management, incident and accident investigation, and human factors



in aviation as a route to increased operational efficiency.

To give the reader an idea of Harris's methodology concerning each topic, the following is an abbreviated account of his discussion of pilot selection. The many references to others' research that he includes are omitted here for the sake of brevity.

No part of human factors can be considered in isolation.

Selection depends on job requirements and person requirements. "'Job requirements' specifies the task competencies needed by job incumbents and the performance standards demanded of them," Harris says. "A competency is the knowledge, skill or ability needed by a successful post holder to perform to the standard required. For example, in addition to the technical skills required of a commercial pilot — the ability to fly the aircraft and manage its systems — there is also a requirement for a successful crewmember to be a good team player," involving not only good leadership skills but also good followership skills: "The first officer must be both assertive and a subordinate, which is a very fine balance to achieve if proper communication and coordination are to occur."

"Person requirements" specifies the attributes of the successful individual. "To complement the basic psychomotor (stick and rudder) skills needed in a pilot, certain personality characteristics may additionally be considered to be desirable," Harris says. He cites studies showing that "commercial pilots were, among other things, emotionally stable and low in anxiety, impulsiveness and depression. They also tended to be conscientious and strive to achieve, possessed a high level of assertiveness, and were trusting and straightforward. Poor pilots had higher neuroticism scores than more successful pilots. These attributes need to be operationalized into measurable quantities that can then be used in a selection context, for example, through the use of a suitable personality inventory."

He notes several commonly used methods of personnel selection, all of which, he says, have strengths and weaknesses depending on the situation.

Interviews are probably used in almost all personnel selection. The merits of the interview technique include that it is a relatively fast and simple way to test communication skills and assess job knowledge; the interviewer can probe in areas that arise during the interview; and the format allows the applicant to ask questions, which might help measure interest, enthusiasm, curiosity and attention.

What could be a problem, then? Harris suggests three possible drawbacks to the interview format, based on understanding the psychology of interpersonal dynamics:

- Interviews are "unreliable and have low validity, especially unstructured interviews." Validity means that the test accurately measures what it is designed to.
- "Negative information is given disproportionate weight in the selection process."
- "Decisions tend to be made within the first few minutes of the interview and based upon stereotypes."

He performs a similar pro-and-con analysis of personality tests, biographical data, cognitive ability tests and work sample tests. And there is further extensive review of the research literature concerning pilot selection.

Above and beyond the details, Harris continually reminds readers of two themes. First, progress based on human factors research is not just an unavoidable cost of doing business to be tolerated by aviation management — instead, it is a boon both for safety and for the bottom line. Second, no part of human factors can be considered in isolation.

He says, for instance, in connection with safety management systems, "The job of the human factors practitioner is to identify, eliminate or minimize hazardous situations. However, if this is not possible, efforts have to be put in to make personnel aware of the hazards, understand the nature of the hazard and have the ability to do so. The safety management function should have links to the selection, training, occupational medicine and engineering functions."

High Speed + Tail Wind + Wet Runway = Overrun

Both pilots had doubts about the landing, but neither called for a go-around.

BY MARK LACAGNINA

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

JETS

'It's Up to You'

Cessna Citation 550. Substantial damage. Seven minor injuries.

As the Citation II neared Manteo, North Carolina, U.S., during a business flight from Tampa, Florida, the morning of Oct. 1, 2010, the flight crew obtained weather reports indicating that the conditions at Manteo's Dare County Regional Airport were deteriorating.

The last report, obtained from the airport's automated weather observing system, said that the surface winds were from 350 degrees at 4 kt, visibility was 1.5 mi (2,400 m) in heavy rain and that there were broken ceilings at 400 ft and 1,000 ft, and an overcast at 1,300 ft.

The pilot-in-command (PIC), the pilot flying, told the copilot that they would conduct one approach and, "if the airport conditions did not look good," they would divert to another airport, said the report by the U.S. National Transportation Safety Board (NTSB).

Both pilots held Citation type ratings. The PIC, 67, had 9,527 flight hours, including 2,025 hours in type. The copilot, 43, had 3,193 flight hours, including 150 hours in type.

Because of the reported wind conditions at the airport, the crew requested clearance to conduct the global positioning system (GPS) approach to Runway 05. However, restricted areas along that approach path were active, and the crew was cleared instead to conduct the GPS approach to Runway 23 and to circle to land on Runway 05. The minimum descent altitudes were 440 ft for the straight-in approach and 600 ft for the circling approach.

According to the pilots, "the airplane crossed the final approach fix on speed (V_{REF} was 104 kt) and at the appropriate altitude, with the flaps and landing gear extended," the report said. "The copilot completed the approach and landing checklist items but did not call out the items because the PIC preferred that copilots complete checklists quietly."

The Citation was on final approach when the PIC told the copilot that they would not circle to land on Runway 05, as planned, because of the low ceiling. "He added that a landing on Runway 23 would be suitable because the wind was at a 90-degree angle to the runway and there was no tail wind factor," the report said. "Based on the reported weather, a tail wind component of approximately 2 kt existed at the time of the accident; and, in a subsequent statement to the Federal Aviation Administration, the pilot acknowledged that there was a tail wind about 20 degrees behind the right wing."

Groundspeed was about 40 kt when the airplane slid off the end of the runway and plunged into Croatan Sound.

The copilot established visual contact with the runway when the Citation was about 200 ft above the minimum descent altitude for the straight-in approach. "The copilot reported that he mentally prepared for a go-around when the PIC stated that the airplane was high about 300 ft above the runway, but neither pilot called for [a go-around]," the report said.

Data obtained from the airplane's enhanced ground-proximity warning system indicated that groundspeed was 127 kt when the Citation touched down about 1,205 ft (367 m) beyond the approach end of the 4,305-ft (1,312-m) runway. Thus, about 3,100 ft (945 m) of runway remained to complete the landing.

"Data from the airplane manufacturer indicated that, for the estimated landing weight, the airplane required a landing distance of approximately 2,290 ft [698 m] on a dry runway, 3,550 ft [1,082 m] on a wet runway or 5,625 ft [1,715 m] for a runway with 0.125 in [3.180 mm] of standing water," the report said.

Moreover, the landing-performance chart in the Citation 550 airplane flight manual "contained a note that the published limiting maximum tail wind component for the airplane is 10 kt but that landings on precipitation-covered runways with any tail wind component are not recommended," the report said.

Cockpit voice recorder data indicated that as the airplane touched down on the runway, the PIC said, "I don't think we're going to do this."

The copilot replied, "It's up to you. Your call."

Both pilots recalled that the speed brakes, thrust reversers and wheel brakes appeared to function normally. However, the copilot perceived that the Citation hydroplaned on the wet runway.

Groundspeed was about 40 kt when the airplane slid off the end of the runway and plunged into Croatan Sound, which is about 50 ft (15 m) from the departure threshold. "As witnesses arrived at the accident site, all of the occupants had exited the airplane and were climbing up the embankment," the report said.

NTSB concluded that the probable causes of the accident were the PIC's "failure to maintain proper airspeed and his failure to initiate a go-around," and that contributing factors were "the copilot's failure to adequately monitor the approach and call for a go-around, and the flight crew's lack of proper crew resource management."

'Excessive' TCAS Maneuver

Boeing 717-200. No damage. One serious injury, one minor injury.

En route from Orlando, Florida, U.S., to White Plains, New York, with 116 passengers and four crewmembers the afternoon of Oct. 26, 2009, the flight crew had begun a descent from Flight Level (FL) 350 (approximately 35,000 ft) over North Carolina when the airplane encountered turbulence.

The captain transferred control of the airplane to the first officer and made a public-address announcement "apologizing to the passengers for the rough ride and assuring them that they were working with ATC [air traffic control] to get a smoother ride at a lower altitude," the NTSB report said.

As the captain turned on the fasten-seat-belt signs, the traffic-alert and collision avoidance system (TCAS) generated an aural "traffic" warning and displayed a red square on the primary flight displays indicating another aircraft at the one o'clock position and slightly lower. Shortly thereafter, the TCAS generated a resolution advisory (RA) to "monitor vertical speed."

The captain reassumed control of the airplane, disengaged the autopilot and "initiated a series of excessive control inputs" while leveling the airplane at FL 330, the NTSB report said.

The control inputs resulted in vertical accelerations of +1.6 g, –0.2 g and +1.4 g within about three seconds. The report said that a flight attendant was seriously injured when she was "thrown into a counter" in the forward galley and that a 10-year-old passenger exiting an aft lavatory sustained minor injuries when he was "tossed to the ceiling and then back down to the floor."

The injured flight attendant and passenger were assisted by flight attendants and by an eye doctor and a retired paramedic who were among the passengers. They were transported by paramedics to a hospital after the airplane landed in White Plains.

"According to the TCAS manufacturer's published guidance, a flight crew should 'promptly but smoothly' follow a TCAS RA," the report said. "The advisories are always based on the 'least amount of deviation from the flight path' while providing safe vertical separation. Typical RAs … require crew response within five seconds and g forces of [not more than] 0.25 g."

Investigators found that this information was not included in the training program and guidance materials provided by the airline for its 717 flight crews.

Unprotected CAT III Approach

Airbus A330-202. No damage. No injuries.

Weather conditions at the destination — Melbourne, Victoria, Australia — had decreased to the minimums required for the instrument landing system (ILS) approach to Runway 16 the night of Sept. 21, 2010. As the A330 descended from cruise altitude with 268 passengers and 11 crewmembers aboard, the flight crew requested a Category (CAT) III (automatic landing system) approach.

"The en route air traffic controller advised that they could expect the approach but that the ILS critical areas would not be protected," said the report by the Australian Transport Safety Bureau. Protecting areas that are critical to the transmission of localizer and glideslope signals during a CAT III approach involves various methods of ensuring that aircraft, ground vehicles and equipment remain clear of the areas, according to the report.

In view of the deteriorating weather conditions, the airport actually had begun the actions necessary to protect the critical areas, or "secure the airport" against ILS signal interference, about 30 minutes before the A330 reached Melbourne, but the actions had not been completed. The aircraft was 11 nm (20 km) from the airport when the airport traffic controller cleared the crew to land and advised them that the airport was not yet secured.

"The crew did not report any interference with the ILS signals" during the CAT III approach, the report said. After landing, they advised the aerodrome controller that the cloud base was at about 160 ft and runway visual range was between 300 and 400 m (1,000 and 1,300 ft). Shortly thereafter, the airport implemented low-visibility procedures.

The report noted that protection of ILS critical areas at Australian airports is not required until low-visibility procedures are implemented officially. In this case, however, the airside safety officer at Melbourne had begun the procedures about 40 minutes before low-visibility procedures were implemented.

"This highlights that the time required to physically secure the airport as part of the low-visibility procedures can be lengthy," the report said. "ATC and aircraft operators need to be aware of and give appropriate consideration to the time required for the airport operator to secure the airport."

'The time required to physically secure the airport as part of the low-visibility procedures can be lengthy.'

Uncommanded Crossfeed

Cessna Citation 680. No damage. No injuries.

The Citation Sovereign was climbing to cruise altitude during a charter flight with five passengers and three crewmembers from London Luton Airport to Turkey the morning of Sept. 30, 2010, when the flight crew received a crew-alerting system message indicating a fault in the left main electrical bus.

The pilots completed the appropriate checklist actions, which included disengaging the left generator, and turned back toward London Luton, which was 20 minutes away and had favorable weather, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

"When the left generator was selected 'OFF,' a number of systems lost power, including the flaps, the left fuel quantity indication and the commander's primary flight display," the report said.

The commander transferred control to the copilot, who found as the flight progressed that an increasing amount of right aileron control input was required to maintain a wings-level attitude. Nevertheless, the crew was able to land the Citation at London Luton without further incident.

The crew had received a false indication of a left main electrical bus fault.

Investigators found that the crew had received a false indication of a left main electrical bus fault because of a malfunctioning circuit board in the aircraft's power-distribution system. Moreover, disengaging the left main electrical bus in compliance with the checklist had caused an uncommanded activation of the fuel-crossfeed system.

The aircraft had departed with a full fuel load of 11,000 lb (4,990 kg). "When the aircraft was powered up again [after landing], all systems appeared to operate normally, including the left fuel quantity indication," the report said. "The left tank fuel quantity indication was approximately 5,500 lb [2,495 kg] (corresponding to full), and the right tank indication was approximately 3,300 lb [1,497 kg]."

The resulting fuel imbalance was 2,200 lb (998 kg). "The maximum permissible lateral fuel imbalance is 400 lb [181 kg], but this can be increased to a maximum of 800 lb [363 kg] in an emergency," the report said.

Tests conducted on the incident aircraft and a similar aircraft showed that isolation of the left main electrical bus caused the crossfeed valve to open and the right fuel boost pump to engage even with the crossfeed switch in the "OFF" position. The result was an uncommanded transfer of fuel from the right tank to the left tank, with "FUEL CROSSFEED" and "R BOOST PUMP" messages displayed by the crew-alerting system.

The report noted that Cessna Aircraft developed modifications to the fuel-control circuit boards in Citation 680s to prevent uncommanded fuel transfer when the left main electrical bus is not powered. The modifications were published in Service Bulletin SB680-24-11 in December 2010 and subsequently mandated by an airworthiness directive issued by the U.S. Federal Aviation Administration.

False Fire Alarm Spurs Evacuation

Boeing 737-800. No damage. Four serious injuries, 21 minor injuries.

The 737 was being taxied for takeoff from Mumbai (India) Airport the night of Aug. 27, 2010, when two standby cabin crewmembers seated on the left side of the aircraft observed what they thought was fire emanating from the left engine. One of the crewmembers went to the rear galley and used the interphone to inform the captain.

The captain saw no cockpit indications of a fire, said the report by India's Directorate General of Civil Aviation (DGCA). He looked out his side window, which offered only a limited view of the left wing, and saw no indication of a fire. He then stopped the 737 on the taxiway and asked the ground traffic controller if he saw fire on the left side of the aircraft. The controller replied that he saw no fire.

The captain phoned the cabin crewmember-in-charge (CCIC) and asked her if she saw a fire. After looking through a window near the rear of the cabin, the CCIC told the captain that there was a fire under the left wing. He told her to conduct a precautionary evacuation from the right side of the aircraft.

The pilots shut down the engines and the auxiliary power unit, informed ATC that they were evacuating the aircraft because of a fire in the left engine and conducted the evacuation checklist.

The report described the evacuation as chaotic. Several passengers did not heed instructions to remove their shoes and to leave their baggage behind. The CCIC instructed the cabin crew to use only the two right cabin doors, but the left rear door, one of the left overwing emergency exits and both right overwing exits were opened as well. Investigators were unable to determine who opened the exits, which were used by several passengers.

Twenty-one of the 139 passengers sustained minor injuries, and four passengers suffered multiple bone fractures during the evacuation. Most of the minor injuries and all of the serious injuries were sustained while using the overwing exits.

Aircraft rescue and fire fighting personnel found no sign of a fire. Subsequent detailed examinations of the aircraft that included a borescope inspection of the left engine also disproved the cabin crew's reports of a fire. Investigators determined that none of the crewmembers had detected smoke or abnormal odors in the cabin before the evacuation was begun.

The report said that the observations of fire emanating from the left engine or from the bottom of the left wing were "imaginative" and based on an illusion created by the wet taxiway's reflection of flickering red light from the belly-mounted anti-collision beacon.

The DGCA concluded that the captain lacked situational awareness and, based on the "illusionary information" that he received, made a "wrong decision" to evacuate the aircraft.

TURBOPROPS

False Assumption About Fuel

De Havilland DHC-8. No damage. No injuries.

As the Dash 8 neared Winnipeg, Manitoba, Canada, the morning of June 29, 2010, the flight crew calculated that 4,200 lb (1,905 kg) of fuel would be required to complete the next leg, a round-trip between Winnipeg and Island Lake. They radioed the fixed-base operator's customer service representative (CSR), provided an estimated time of arrival, placed a fuel order and requested that a fuel truck meet the aircraft to facilitate a quick turnaround.

The CSR then became distracted by other tasks and did not pass the fuel order to the line service foreman, said the report by the Transportation Safety Board of Canada (TSB). After the aircraft landed and the engines were shut down, a fuel truck operator moved the truck into position and connected a hose to the aircraft.

Although the pilots were required by company procedure to monitor refuelings, the captain walked away from the aircraft, as did the first officer after conducting a post-flight inspection. "Both pilots saw the fuel truck and assumed the fuel truck operator knew the desired fuel load," the report said. "They did not reiterate or otherwise communicate their fuel requirements."

Meanwhile, the fuel truck operator was informed that another aircraft required refueling. He attempted unsuccessfully to locate the Dash 8 pilots before refueling the other aircraft. When he returned to the Dash 8, he made another unsuccessful attempt to locate the pilots. He radioed the foreman for instructions and was told to attend to yet another aircraft awaiting refueling.

When the pilots returned to the Dash 8, "the fuel truck and operator were gone, and both pilots assumed the aircraft had been fueled," the report said. "Neither pilot checked the fuel quantity."

After departing with 22 passengers and a flight attendant, the pilots realized while conducting the 10,000-ft climb check that they did not have enough fuel aboard to safely complete the flight. They returned to Winnipeg and landed with 900 lb (408 kg) of fuel remaining.

Lightning Damages Elevator

Beech 1900C. Substantial damage. No injuries.

The flight crew used the airplane's weather radar system to circumvent thunderstorms during a cargo flight from Juneau, Alaska, U.S., to Sitka the morning of Oct. 18, 2010. "Once clear of the thunderstorms, they flew direct to the initial instrument approach fix" for the GPS approach to Runway 11, the NTSB report said.

The 1900 was about 2 nm (4 km) from the final approach fix when the pilots and an observer occupying the jump seat saw a buildup of static electricity, or St. Elmo's fire, near the airplane's nose. "The first officer [the pilot flying] reported that the light from the static electricity was very bright, and he decided to keep his eyes focused on the instruments," the report said.

Shortly thereafter, lightning struck the nose of the airplane. "The lightning flash blinded the captain and the observer for about 30 seconds," the report said. "The first officer was looking at the instrument panel when the lightning flash occurred, so he did not lose his sight."

The approach and landing were completed without further incident. A subsequent examination of the 1900 revealed that the lightning strike had caused substantial damage to the right elevator.

Faulty Gauge Prompts RTO

De Havilland DHC-6-300. Substantial damage. No injuries.

The Twin Otter was departing from the 650-m (2,133-ft) runway at Bituni Airport in West Papua, Indonesia, the morning of July

18, 2010. Shortly after calling "rotate," the PIC, the pilot monitoring, saw the torque indication for the right engine drop to zero and called "fail, fail."

The copilot rejected the takeoff, applying maximum wheel braking and reverse thrust. The tire on the right main landing gear burst, and the aircraft veered off the right side of the runway, where the nose landing gear collapsed. The seven passengers and the pilots were not injured.

The report by the Indonesian National Transportation Safety Committee noted that the calculated rotation speed for the takeoff was the same as V_1, the maximum speed at which a rejected takeoff (RTO) should be initiated. "An aborted takeoff should not be performed after passing the V_1 speed," the report said.

Investigators found that the torque indication seen by the PIC was false, caused by a melted fuse in the electrical circuit for the right torquemeter. The same problem apparently had been experienced by another flight crew two weeks earlier; the report provided no details about that incident.

PISTON AIRPLANES

Frost Blamed for Stall

Gippsland GA8 Airvan. Substantial damage. One serious injury, one minor injury.

The AAIB report said that the aircraft had been parked outside overnight, and there had been a heavy frost. However, the pilot said that he noticed no ice or frost on the wings when he prepared the aircraft for a parachuting flight from Swindon, Wiltshire, England, the morning of Nov. 28, 2010.

Shortly after lifting off about 90 m (295 ft) from the end of the 650-m (2,133-ft) wet grass strip, the pilot began a left turn to comply with the airport's noise-abatement policy. "During the turn, he realized the aircraft was descending and checked the engine instruments, observing that the MAP [manifold pressure], fuel pressure and rpm were indicating correctly," the report said.

The pilot called "brace" three times to prepare his passengers for impact. The aircraft hit the ground immediately afterward in a left-wing-low attitude. The pilot received a serious leg injury; a parachutist sustained whiplash injury; the other seven passengers escaped injury.

Examination of the Airvan revealed a layer of frost on the upper surface of the wing. "The layer, which was difficult to discern against the white paint on the wing, was approximately 1 mm [0.04 in] thick and had a texture similar to medium-grade sandpaper," the report said.

The AAIB concluded that the frost likely had caused the aircraft to stall at an airspeed corresponding to an angle-of-attack that was too low to trigger a stall warning and at a height that was too low to allow a recovery.

The report cited U.K. Civil Aviation Authority *Safety Sense Leaflet 3*, which states: "Tests have shown that frost, ice or snow with the thickness and surface roughness of medium or coarse sandpaper reduces lift by as much as 30 percent and increases drag by 40 percent."

Control Lost During Night Approach

Cessna 414A. Destroyed. Two fatalities.

The pilot, who had a multiengine rating but no experience as a PIC in twins, was required by his insurance company to fly his newly purchased 414 for the first 20 hours with "a more experienced pilot," the TSB report said. Therefore, the pilot had arranged for another pilot to serve as PIC for the first flight, from Toronto to Sydney, Nova Scotia, on Aug. 5, 2010.

The PIC had 530 flight hours and owned a Cessna 340, but he had no experience in a 414. Before departing from Toronto with the owner, he received 1.5 hours of ground instruction and one hour of flight instruction in the aircraft with a check pilot who was experienced in type. "The training consisted of steep turns, slow flight and autopilot work," the report said. "Aerodynamic stalls were not practiced due to turbulence."

Night had fallen when the PIC and the owner departed from Toronto. Investigators were unable to determine who was the pilot flying, but the report noted that the PIC made all radio transmissions.

The flight to Sydney was uneventful, and the pilots were cleared to conduct the global navigation satellite system (GNSS) approach to Runway 25. Weather conditions at the airport included winds from 200 degrees at 8 kt, 12 mi (19 km) visibility and a broken ceiling at 700 ft.

The initial portion of the approach was over water. The report said that the pilots did not comply with several ATC instructions to reduce speed due to another aircraft ahead on the approach. The 414 was nearing the final approach waypoint when the pilots were instructed to turn right and return to the initial approach waypoint.

The 414 was turned left instead and flew an erratic flight path for about four minutes. "The aircraft changed heading numerous times, with altitude deviations of up to 500 ft, which was consistent with the aircraft being flown manually, possibly while the GPS was being reprogrammed," the report said.

ATC told the pilots twice to descend to 3,000 ft. Although the PIC acknowledged the instructions, the aircraft did not descend. The controller then cleared the pilots to conduct the GNSS approach to Runway 25, but there was no response. After the controller repeated the clearance, the PIC responded with the call sign of his 340.

The controller offered radar vectors, but the PIC declined, saying that they were re-established on a heading direct to the initial approach waypoint. Shortly thereafter, the 414 was observed on ATC radar to enter a right turn and descend rapidly in what the report described as a spiral dive. The aircraft struck the water in a near-vertical attitude.

"It is likely that the PIC and the owner were both suffering some degree of spatial disorientation during the final portion of the flight," the report said. "This resulted in loss of control of the aircraft."

HELICOPTERS

Snow Suffocates Engine

Bell 407. Substantial damage. Two serious injuries, one minor injury.

The helicopter had been parked outside on a helipad in Decatur, Texas, U.S., for about five hours in blowing snow before engine inlet plugs and exhaust covers were installed. The 407 then remained outside for about 19 hours in temperatures ranging from well below to slightly above freezing.

Film from a surveillance camera showed that no one inspected the engine inlets and exhaust stacks or opened any access panels before the helicopter departed for an emergency medical services positioning flight the afternoon of Dec. 25, 2009.

The helicopter was about 60 ft above ground level when it yawed 90 degrees left. The pilot heard two warning horns and attempted to return to the helipad. However, he was unable to recover rotor rpm before the helicopter struck the ground hard, collapsing the skids but remaining upright. The pilot and the flight medic were seriously injured, and the flight nurse sustained minor injuries.

Investigators determined that the engine had flamed out momentarily after ingesting snow or ice that had accumulated in the intakes.

Runaway Golf Cart Hits Tail Rotor

Eurocopter AS 355-F1. Substantial damage. No injuries.

The pilot said that he confirmed the area was clear before starting the helicopter's engines in preparation to depart from a golf course in Essex, England, for a positioning flight the afternoon of Oct. 23, 2010.

"Shortly after starting the second engine, he noticed a golf cart on his right side that was 'traveling at some speed, clearly out of control,'" said the AAIB report. The roof of the golf cart struck the tail rotor, causing damage to the rotor blades, gearbox, drive train and vertical stabilizer.

The pilot, who was not injured in the accident, said he was told that a young child who was climbing into the golf cart with an adult had inadvertently stepped on the accelerator pedal. "The pilot estimated that the cart had traveled 80 m [262 ft] before hitting the tail rotor," the report said. "The occupants of the cart were unhurt."

Preliminary Reports, September 2011

Date	Location	Aircraft Type	Loss Type	Injuries
Sept. 2	Robinson Crusoe Island, Chile	CASA 212	total	21 fatal
Witnesses lost sight of the aircraft as it turned after making two visual approaches to the island airport. Debris subsequently was found floating on the Pacific Ocean.				
Sept. 2	Mumbai, India	Airbus A340	major	104 minor/none
The A340 was entering a high-speed taxiway during a night landing when it veered off the wet runway onto soft ground.				
Sept. 2	Herceg-Novi, Montenegro	Aerospatiale Gazelle	total	3 fatal
The helicopter crashed out of control after striking a wall during an attempted landing.				
Sept. 2	Nightmute, Alaska, U.S.	Cessna 208 Caravan	total	1 fatal
The Caravan crashed out of control after a midair collision with a Cessna 207. The 207 was substantially damaged, but the pilot was not injured.				
Sept. 4	Ottawa, Ontario, Canada	Embraer 145	major	47 minor/none
The 145 veered off the left side of Runway 32 while landing in heavy rain and surface winds from 270 degrees at 13 kt, gusting to 25 kt.				
Sept. 4	Mashhad, Iran	Airbus A300	major	3 serious, 227 minor/none
The A300 veered off the runway after a nose landing gear tire burst during a hard night landing. Three passengers were injured during the emergency evacuation.				
Sept. 6	Trinidad, Bolivia	Fairchild Metro	total	8 fatal, 1 serious
Visibility was 1,500 m (5,000 ft) in smoke when the Metro crashed during a night instrument approach.				
Sept. 7	Yaroslavl, Russia	Yakovlev 42	total	44 fatal, 1 serious
The Yak-42 overran the runway on takeoff and crashed on the banks of the Volga River.				
Sept. 7	Johannesburg, South Africa	Cessna 208 Caravan	major	1 minor/none
The pilot rejected the takeoff when the engine lost power shortly after liftoff. The Caravan overran the runway, and the nose landing gear collapsed.				
Sept. 9	Pasema District, Indonesia	Cessna 208 Caravan	total	2 fatal
Both pilots were killed when the Caravan struck mountainous terrain during a cargo flight.				
Sept. 13	Groblersdal, South Africa	Bell 230	total	6 minor/none
The pilot lost visual contact with the ground in a brownout while landing on a soccer field. The helicopter struck a post, crashed and burned.				
Sept. 14	Huambo, Angola	Embraer Brasilia	total	17 fatal, 1 serious, 6 minor/none
The Brasilia crashed on takeoff in day visual meteorological conditions (VMC).				
Sept. 14	Vallorcine, France	Eurocopter AS 350	total	4 fatal
The helicopter crashed after the tail rotor struck cables during an approach to a landing site at a dam in the Alps.				
Sept. 16	Quito, Ecuador	Embraer 190	total	105 minor/none
Thunderstorm activity was reported when the 190 overran the runway during a night landing and struck a localizer antenna and the airport perimeter wall.				
Sept. 18	El Puerto de Santa María, Spain	Bell 206	total	3 serious
The helicopter was filming various locations near the center of the city when it struck buildings and crashed on a narrow street.				
Sept. 19	Granada, Spain	Bell 412	total	3 fatal
The helicopter struck mountainous terrain during a ferry flight to a fire-fighting base.				
Sept. 20	Milot, Haiti	Beech 99	total	3 fatal
The aircraft crashed in heavy rain about 10 mi (16 km) from the destination, Cap-Haïtien.				
Sept. 22	Yellowknife, Northwest Territories, Canada	de Havilland Twin Otter	total	2 fatal, 3 serious, 4 minor/none
The float-equipped aircraft struck buildings after the pilots rejected a landing on a seaplane base in strong, gusting winds.				
Sept. 25	Kathmandu, Nepal	Beech 1900	total	19 fatal
The 1900 was on a downwind leg to land when it struck a fog-shrouded hill about 1,000 ft above airport elevation.				
Sept. 26	Puerto Ordaz, Venezuela	Douglas DC-9	total	130 minor/none
Day VMC prevailed when the DC-9 landed very hard, separating both engine pylons from their fuselage attachment points.				
Sept. 29	Kutacane, Sumatra, Indonesia	Indonesian Aerospace 212	total	18 fatal
The ceiling was 1,700 ft when the aircraft crashed in mountainous terrain about 15 mi (24 km) southeast of Kutacane, the destination.				

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

Source: Ascend

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