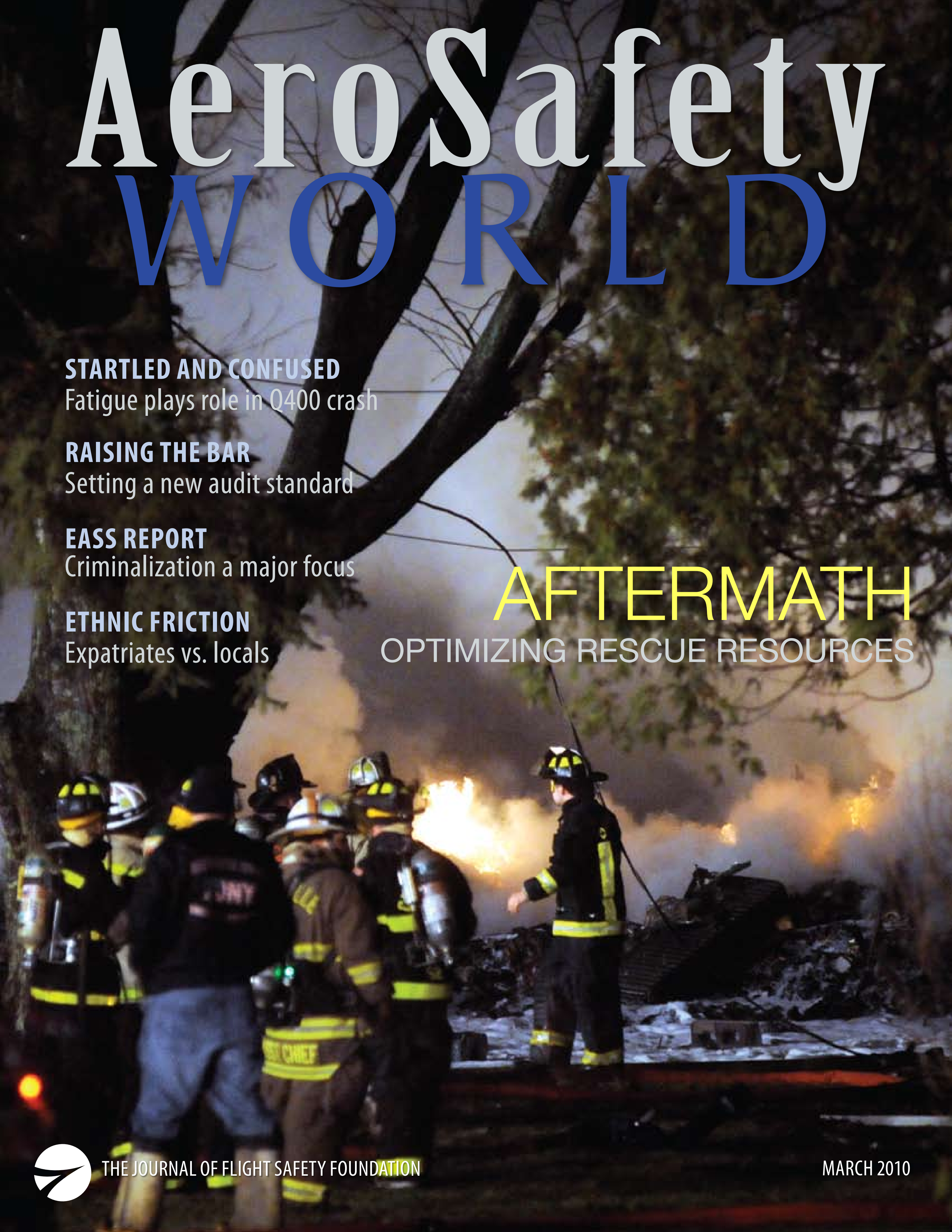

AeroSafety WORLD

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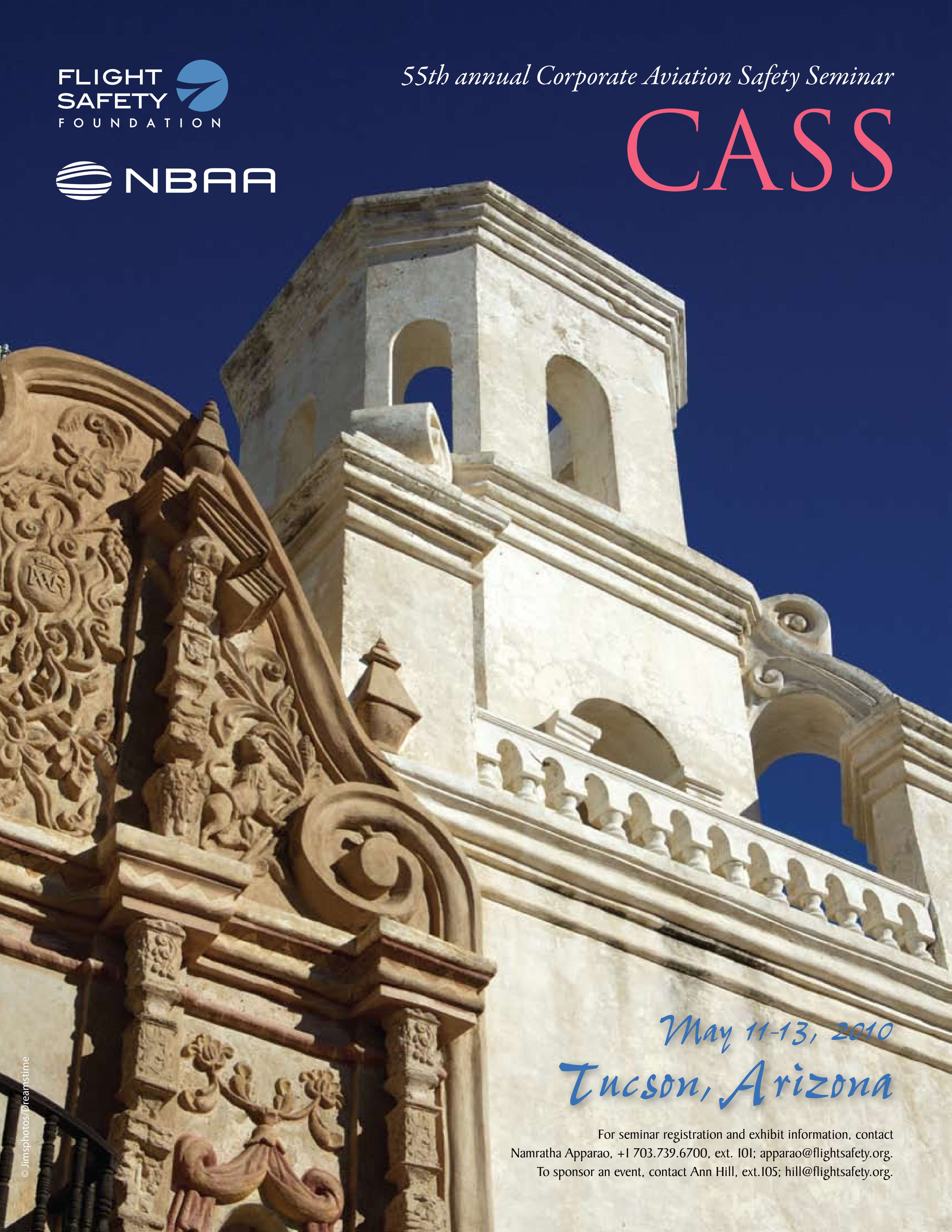
THE JOURNAL OF FLIGHT SAFETY FOUNDATION

MARCH 2010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BUILDING ON THE Basics

Lately, several high-profile accidents and incidents have involved violations of basic sterile cockpit procedures. This troubles me, and I know that I am not alone. The U.S. National Transportation Safety Board recently suggested that monitoring of cockpit voice recorders (CVRs) should be considered to keep crews on their toes and discourage this sort of unprofessional behavior. I have not been very supportive of that position, and I should explain why.

To be honest, it is painful to think that things have slipped so far that we have to consider this option. I worry this will demoralize good professionals who have already endured a thousand other indignities. But at the end of the day, I get it. Lives are at stake. If this is the only answer, we will have to seriously consider it, but I would suggest that we don't run off in this difficult new direction until we have the other basic safety building blocks in place. We have to consider the opportunity cost of the CVR monitoring. There has never been a time when safety resources were stretched so thin, or when safety was less a priority. Everyone's first worry is the economy, then security, then the environment, and then maybe safety. To some extent, this is due to a safety record that is pretty good; there is no crisis. The best we can hope for is a zero-sum game. In this environment, safety priorities have to be set carefully.

So let me discuss the pieces I think have to be put in place before we take on something as difficult as monitoring CVRs. This discussion is being led from the United States, and there we are still missing a vital piece of the puzzle. In response to a recent call to action from the administrator of the U.S. Federal Aviation Administration, many U.S. regional airlines have committed to voluntary flight operational quality assurance (FOQA) programs, and new Congressional legislation may make these programs mandatory. But many of these programs are still in their infancy, and some of the airlines that need them the most are lagging.

Would a FOQA program have prevented the lack of cockpit discipline that preceded the Colgan crash? Maybe not, but it might have prevented the accident. I am sure that crew was not the first one to be surprised by an unexpected stick shaker with the deicing system activated. That sort of problem, or a hundred other training deficiencies, would have been flagged if FOQA had been in place. It might have even told us about an accident that hasn't happened yet. When crews know a FOQA program is in place, they operate differently. They know odd excursions will be questioned. They report mistakes, because they would rather admit them under a reporting program than wait for the chief pilot to ask.

We know FOQA programs work. They have been an international requirement since 2005. We know they help drive voluntary reporting. We also know that FOQA plus voluntary reporting plus line operations safety audits provide a very complete picture of risk in the operation. Am I fundamentally against using data from the CVR? Not really, but I am against diverting resources from the things that are needed and the things that are proven. Let's get the basics in place first.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafetyWORLD

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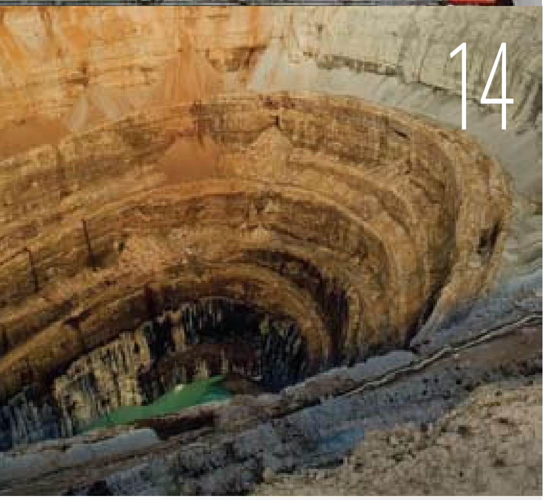

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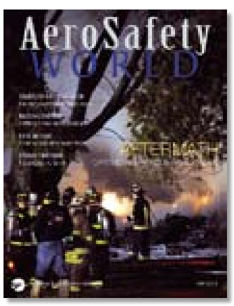

About the Cover
Coordinating the response to an off-airport crash.
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UNINTENDED Consequences

Cockpit failures that contributed to the crash of a Colgan Air Q400 near Buffalo, New York, U.S., early last year have moved the U.S. Congress to action. Whenever legislative bodies start writing aviation operating rules I get nervous, and this time my unease is fully justified. Generally, when that happens, bad comes out along with the good, and we hope that calm heads will rule the day. This time, however, the bad may prevail.

Members of Congress, alarmed by the Colgan captain's poor piloting skills, compounded by a relatively inexperienced first officer's response, are legislating a solution.

The initial bill, passed last year in the House of Representatives, would require both pilots in a Federal Aviation Regulations Part 121 operation to have air transport pilot (ATP) certificates, which means each will have at least 1,500 hours of flight time. When this was announced, I imagined crew-scheduling officials across the land, especially those working at regional airlines, clutching their chests, fighting for breath as they imagined how hard it would be to keep their airline flying anything close to a reasonable schedule with such an experience investment in each cockpit.

At first blush this seemed to be a boon to the sophisticated flight schools, the Mercedes/Cadillac-level folks like the University of North Dakota, Embry-Riddle Aeronautical University or even my smaller alma mater further down the beach, Florida Tech, which could cash in on this sudden need for ATP tickets. But then the broader, longer-term picture began to take shape, and the outlook for these grade-A flight schools appeared fairly grim.

These schools do a lot of business pumping out well-educated pilots with a fresh commercial pilot license and around 250 hours, financed by student loans and/or parents' support, positioning these graduates to go directly into a Part 121 operation. Suddenly that track would be closed. Now, fledgling pilots could not afford to build their needed time in a classic aviation university and would have to hold down costs to acquire more time on their own while competing for the few commercial jobs that would help accumulate the needed experience, and the grade A schools would become much less valuable to prospective students.

The recently passed Senate bill reduced that needed flight time to 800 hours, and obviously shelved the ATP requirement, but as this is written the House repassed its bill with the pilot-experience part changed only in giving FAA some wriggle room. The last chance for a good outcome for this mess is in the conference committee that will try to smooth out the differences between the two bills.

The growing worldwide shortage of trained aviation professionals, already set to accelerate as economies recover, will be severely strained if this part of the bill is adopted in the final version. Given that the House bill also requires non-U.S. repair stations working on U.S.-registered aircraft to have direct FAA inspections twice a year — an internationally contentious rule that has no foundation in reality — and that airlines get fresh government approval for their alliances every three years, it is clear that the House doesn't mind creating chaos in the aviation world so long as its motivation at least appears righteous.

J.A. Donoghue

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

Serving Aviation Safety Interests for More Than 60 Years

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

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CALL FOR PAPERS ➤ 41st Annual Seminar of the International Society of Air Safety Investigators. Sapporo, Japan, Sept. 6–9. Bob Matthews, <bob.matthews@faa.gov>.

MARCH 16–18 ➤ Dangerous Goods Inspector Initial Training. U.K. Civil Aviation Authority International. London Gatwick. Sandra Rigby, <training@caainternational.com>, <www.caainternational.com/site/cms/coursefinder.asp?chapter=134>, +44 (0)1293 573389.

MARCH 17–19 ➤ Spring Conference: Leadership and Advocacy. Association of Air Medical Services. Washington, D.C. Natasha Ross, <nross@aams.org>, <www.aams.org/Content/NavigationMenu/EducationMeetings/SpringConference/default.htm>, +1 703.836.8732, ext. 107.

MARCH 22–24 ➤ CHC Safety and Quality Summit. CHC Helicopter. Vancouver, British Columbia, Canada. <summit@chc.ca>, <www.chcsafetyqualitysummit.com/default.aspx>, +1 604.232.7424.

MARCH 22–24 ➤ Aircraft Accidents Crisis Preparedness and Management Conference. Singapore Aviation Academy. Singapore. Jasmin Neshah Ismail, <Jasmin_Ismail@caas.gov.sg>, <www.saa.com.sg/saa/en/index.html>, +65 6540 6209.

MARCH 22–26 ➤ Aviation Lead Auditor Training. Argus Pros. Denver. John H. Darbo, <www.pros-aviationservices.com/alat_training.htm>, +1 513.852.1057.

MARCH 24–25 ➤ AQD Customer Conference. Superstructure Group AQD Safety and Risk Management. Hong Kong. Liz Swanston, <liz.swanston@superstructuregroup.com>, <www.superstructuregroup.com>, +64 4385 0001.

MARCH 28 ➤ IS-BAO Workshop. National Business Aviation Association. New Orleans. Jay Evans, <jevans@nbaa.org>, <www.nbaa.org/events/pdp/is-bao/20100328.php>, +1 202.783.9353.

MARCH 29–APRIL 1 ➤ AMC — Improving Maintenance and Reducing Costs. ARINC. Phoenix. Sam Buckwalter, <sbuckwal@arinc.com>, <www.aviation-ia.com/amc>, +1 410.266.2008.

MARCH 29–APRIL 1 ➤ High Level Safety Conference. Civil Air Navigation Services Organisation. Montreal, Quebec, Canada. Anouk Achterhuis, <events@canso.org>, <www.canso.org/cms/showpage.aspx?id=1286>, +31 (0)23 568 5390.

MARCH 31–APRIL 1 ➤ Aviation Human Factors and SMS Wings Seminar. U.S. Federal Aviation Administration Wings Pilot Proficiency Program. Dallas. Kent B. Lewis, <lewis.kent@gmail.com>, <www.signalcharlie.net/conference+2010>, +1 817.692.1971.

APRIL 5–9 ➤ IOSA Auditor Training. Argus Pros. Denver. John H. Darbo, <www.pros-aviationservices.com/iat_training.htm>, +1 513.852.1057.

APRIL 13–14 ➤ Fatigue Risk Management 2010. Circadian Australia. Melbourne, Victoria, Australia. Janet Reardon, <seminars@circadian.com>, <www.circadianaustraliaseminar.webls.info>, +1 781.439.6388.

APRIL 13–15 ➤ Cabin Safety Workshop. U.S. Federal Aviation Administration Civil Aerospace Medical Institute. Oklahoma City, Oklahoma, U.S. Lawrence Paskoff, <lawrence.paskoff@faa.gov>, <www.faa.gov/data_research/research/med_humanfacs/aeromedical/cabinsafety/workshops>, +1 405.954.5523.

APRIL 19–21 ➤ Human Factors Train-the-Trainer. The Aviation Consulting Group. San Juan, Puerto Rico. Bob Baron. <tacg@sccoast.net>, <www.tacgworldwide.com/humanfactorstraining.htm>, 800.294.0872 (U.S. and Canada), +1 954.803.5807.

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

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

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

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

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

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

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

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

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

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

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

Safety News

Better Communications

The U.S. National Transportation Safety Board (NTSB), citing an Oct. 21, 2009, incident in which the pilots of a Northwest Airlines Airbus A320 were out of contact with air traffic control (ATC) for more than one hour as they flew past their destination airport, is recommending new procedures for documenting radio communications.

The NTSB said in its final report that the pilots failed to maintain radio communications because they were distracted by "a conversation unrelated to the operation of the aircraft." After they re-established radio communications, they returned to their destination airport in Minneapolis and landed the airplane.

"The investigation found that the pilots had become engaged in a conversation dealing with the process by which pilots request flight schedules, and during the conversation, each was using his personal laptop computer, contrary to company policy," the NTSB said. "The pilots were not aware of the repeated attempts by air traffic controllers and the airline to contact them."

The NTSB said that the investigation identified "deficiencies in ATC communications procedures" — ATC procedures for documenting communication with flight crews and for identifying emergency communications.

As a result, the NTSB issued two safety recommendations to the U.S. Federal Aviation Administration (FAA). One called on the FAA to "require air traffic controllers to use standard phraseology, such as 'on guard,' to verbally identify transmissions over emergency frequencies as emergencies."

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The other said the FAA should "establish and implement standard procedures to document and share control information, such as frequency changes, contact with pilots and the confirmation of the receipt of weather information, at air traffic control facilities that do not currently have such a procedure." The NTSB said these changes "should provide visual communication of at least the control information that would be communicated by the marking and posting of paper flight-progress strips."

Surface Vehicle Safety

The Australian Civil Aviation Safety Authority (CASA) has proposed new regulations to govern vehicles that operate on aircraft maneuvering areas at several major airports.


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There are no current regulations governing the entry, movement and surveillance of vehicles in these areas. The proposed regulations would give CASA the authority to designate airports that would be required to have advanced surface movement guidance and control systems.

The regulations would require that vehicles operating at those airports be equipped with radios and electronic devices compatible with surface surveillance. They also would prohibit unequipped vehicles from entering aircraft maneuvering areas "without a close escort, and require vehicle drivers to monitor and communicate with air traffic control," CASA said.

The regulations would affect operations at airports in Sydney, Brisbane, Melbourne and Perth.

SMS for FAA

The U.S. Federal Aviation Administration (FAA) Air Traffic Organization has adopted a safety management system (SMS) that the agency says provides for managing risks associated with changes in the national airspace system.

FAA Administrator Randy Babbitt said the new SMS enables the agency to manage "the challenges of introducing new technology into the national airspace system. Practically speaking, SMS is as important as the new technology itself."

As an example, he said that SMS would provide a framework for conducting a risk analysis as NextGen technology is introduced into the system. Such an analysis was conducted on automatic dependent surveillance–broadcast (ADS–B) equipment before it began operating in the Gulf of Mexico, he said (*ASW*, 2/10, p. 14).

Million-Dollar Penalty Proposal

The U.S. Federal Aviation Administration (FAA) has proposed penalties totaling more than $1 million against American Airlines for four maintenance violations ("Oversight Overlooked," p. 54).

The largest of the four proposed penalties is $625,000 and stems from an April 2008 case in which the FAA says that American Airlines maintenance personnel diagnosed problems in a McDonnell Douglas MD-82's central air data computer (CADC) but, instead of replacing the unit, they improperly deferred action under the minimum equipment list (MEL).

However, the MEL "does not allow deferral of an inoperative CADC," the FAA said. "The airline subsequently flew the plane on 10 passenger flights before the computer was replaced. During this time, flight crews were led to believe that both computers were working properly."

The FAA also proposed a $300,000 civil penalty for a Feb. 2, 2009, case in which the airline's maintenance personnel deferred maintenance on an MD-82 under the MEL because a "pitot/stall heater light OFF light on the aircraft's annunciator panel was inoperative." The following day, technicians determined that the inoperative part was not the light but the captain's pitot probe heater.

The MEL provides for deferred maintenance on pitot probe heaters only if flights are restricted to daytime visual meteorological conditions without flight into known or forecast icing conditions or visible moisture.

Wikimedia

A $75,000 penalty was proposed for what the FAA described as the airline's failure to correctly comply with an airworthiness directive for the inspection of Boeing 757 rudder components. The FAA proposed an $87,500 fine for a case involving what the agency said was the return to service of an MD-82 although records indicated that several steps of scheduled B-check maintenance were not checked as completed and replacement of a landing gear door was not noted in aircraft logbooks.

In each instance, the airline had 30 days to respond to the FAA's proposal.

Transfer of Oversight

Transport Canada plans to resume its control of the certification and oversight of business aircraft — functions that currently are performed by the Canadian Business Aviation Association (CBAA).

The change, which takes effect April 1, 2011, will include the issuance of operating certificates and the processing of changes in existing certificates. Operators will remain responsible for complying with maintenance requirements, and Transport Canada will continue to assess their compliance.

Transportation Safety Board of Canada

On April 1, 2010, and throughout the year preceding the transfer of certification and oversight responsibilities, Transport Canada said, it will "begin enhancing surveillance of the association's certification and oversight functions" and "conduct a complete review of its surveillance and regulatory structure for business aviation operations."

Transport Canada's announcement follows criticism of its arrangement with CBAA by the Transportation Safety Board of Canada (TSB) and others. The TSB's comments were included in its final report on the Nov. 11, 2007, crash of a Bombardier Global 5000 at Fox Harbour Aerodrome in Nova Scotia in which two people were seriously injured (*ASW* 12/09–1/10, p. 18 and p. 22).

In the report, the TSB said that the accident "needs to be considered in the context of a relatively new and evolving safety regulatory environment" featuring safety management systems (SMS). The principles of SMS, which were behind the CBAA's development of safety standards for business aviation, gave the operators "significant responsibility for safety management" but also left them "twice removed from Transport Canada's scrutiny," the TSB said, noting that SMS is a "useful and practical tool … [that] requires the development of an appropriate balance between the responsibilities of the regulator, the operator and (in this instance) the delegated agency." In this case, the TSB said, the appropriate balance "has not been established."

Canadian Watchlist

The risk of collisions on runways is among the most critical safety issues in Canada's transportation system, the Transportation Safety Board (TSB) said in releasing its "Watchlist" of nine items that present the greatest risks to Canadians.

"There is no higher priority" than the listed items, said TSB Chair Wendy Tadros. "It's time for industry and regulators to step up and tackle these nine critical issues."

Tadros said the list was developed after TSB analysts identified "troubling patterns" in their accident investigation work.

"Many times, we arrive on the scene of an accident and see the same safety issues — issues that we have raised before," she said.

The TSB said that, from 1999 to 2007, some 3,831 runway incursions were reported at Canadian airports.

"Given the millions of takeoffs and landings each year, incursions are rare," the TSB said. "However, the consequences can be catastrophic. The Board is concerned that incursions and the risk of collisions will remain until better defenses are put in place."

The TSB reiterated its past recommendations calling for improved procedures and the use of enhanced collision warning systems.

Two other aviation issues were included on the Watchlist:

- Collisions with land and water that occur while aircraft are under crew control — a risk typically classified as controlled flight into terrain (CFIT); and,
- The risk of collisions on runways.

The TSB said that, between 2000 and 2009, there were 129 CFIT accidents in

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Canada that resulted in 128 fatalities. Past TSB recommendations have included a call for ground proximity warning systems in smaller aircraft. "Without this technology, passengers and crews continue to be at risk," the TSB said.

The TSB said that, to reduce the risk of landing accidents and runway overruns, pilots need timely information about runway surface conditions, and airports must extend safety areas at the end of runways "or install other engineered systems and structures to safely stop planes that overrun."

Low Approaches

Eurocontrol says that one European nation — which it does not name — has failed to establish operating minimums for its airports, causing pilots of some aircraft to conduct approaches and land when the runway visual range (RVR) is below the applicable minimum.

© Eurocontrol

"Consequently, air traffic controllers are not aware of such limitations (i.e., that for each instrument approach at a particular aerodrome, there is a minimum which no operator should go below)," Eurocontrol said. "Furthermore, the controllers do not have in place a procedure(s) to act as a safety check when a commander decided to commence an approach to land when the reported RVR is less than the specified minimum."

European regulations say that minimums adopted by individual operators must not be lower than those specified in the European Aviation Safety Agency's EU OPS 1.

Eurocontrol asked air navigation service providers and aircraft operators to comment on what actions controllers should take if a captain indicates that he or she plans to begin an approach when the RVR is below the lowest minimum for that airport.

In the News …

The **SESAR Joint Undertaking** — the technological arm of the Single European Sky project — says it has spawned nearly 300 separate programs intended to modernize air traffic management throughout Europe. A task force is scheduled to report later this year on how to implement the programs. … The Civil Aviation Safety Authority and the Australian Transport Safety Bureau have signed an agreement clarifying their complementary roles in enhancing aviation safety in **Australia** and pledging to make the most effective use of accident investigation findings. … The International Civil Aviation Organization (ICAO) has offered to help coordinate reconstruction of the civil aviation infrastructure in **Haiti**, which was heavily damaged in the January earthquake. ICAO Secretary General Raymond Benjamin said the goal is to reconstruct a system that conforms to ICAO standards and avoid duplication of efforts by donor nations and organizations.

Compiled and edited by Linda Werfelman.

Mixed CULTURE

BY JOSHUA AMARA

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Strained relationships between Nigerian and expatriate maintenance technicians interfere with common safety objectives.

There is no valid reason why aviation maintenance technicians of different races, tribes and cultures cannot learn to work together in a friendly environment, enjoying equal career opportunities within the maintenance, repair and overhaul facilities in Nigeria. However, in my country — and, indeed, in many parts of sub-Saharan Africa — a peculiar condition persists.

This condition originated partly from the historical inequalities of the labor system passed down from the time of British colonial rule, which lasted from the 19th century until Nigerian independence in 1960. Created to benefit European colonial masters, the old system's legacy still has a negative influence on aviation safety culture from the perspective of human factors.

Nowadays, the norm for aviation professionals in the most developed countries is to work in harmony with colleagues from different parts of the world. The working conditions are expected to be the same for all to ensure optimal performance and productivity of every employee.

The contrast in Nigeria is that maintenance technicians tend to be arbitrarily categorized and subcategorized. This troubling division separates the workforce into expatriate personnel and indigenous Nigerian citizens, who are differentiated as *indigenes* or *locals*. Moreover, the indigenes in these facilities create divisions among themselves on the basis of their majority or minority ethnic/tribal affiliation. The expatriates also tend to subdivide themselves into staff of Western European origin — including those from North America — and staff from places such as Eastern Europe, Russia, Asia and Latin America.

Today's system impedes both the advancement of individual Nigerian aviation professionals and airline industry progress by generating excessively high operating costs. The cost of keeping expatriate employees in the country is much higher than otherwise should be necessary, including costs of such things as risk allowances for those who agree to stay and work, monthly round-trip airfare to enable employee visits to their home countries during time off, local transportation with personal security services, and company payment of electric and communication utilities.

It has become normal for rates of remuneration and incentive pay under contracts of employment to depend largely on a person's origin, not just a person's competence. It is also sad to note that the present compensation of the locals is much lower than their foreign counterparts, even if an expatriate has less qualification and experience. This is a great setback — one that, I believe, ultimately detracts from the safety of both the maintenance performed and flight operations.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to J.A. Donoghue, director of publications, Flight Safety Foundation, 601 Madison St., Suite 300, Alexandria VA 22314-1756 USA or donoghue@flightsafety.org.

The emphasis on qualifying expatriates to work in Nigeria diverts limited resources from training Nigerian staff. Company executives who set the priorities must realize that some Nigerian maintenance technicians have worked for years without opportunities for additional qualification or refresher training.

At my airline, we have tried as much as possible to ensure that there is no difference in treatment, that it doesn't matter where you come from — it's only a matter of what you can offer. We also have been educating maintenance employees, preaching the message, "If you work with the expatriates, you're going to gain more knowledge, and the more knowledge you have, the more opportunity you will have to develop in your career here."

In many places, however, several problems are common. For example, cultural differences are not accommodated. Yet culture binds people as members of a group and provides key clues as to how to behave in both normal and unusual situations.

Communication is impaired. Due to both language and cultural differences, there are bound to be not only errors in understanding but also some basic differences in the ways of reasoning. In Nigeria, English often is not the "mother tongue" (first language learned) of either locals or expatriates.

Language generates errors. Most errors discovered during maintenance checks occur because of the "direct" or "literal" translations between the maintenance technician's first language and English. This is quite visible when going through maintenance entries in technical logbooks.

Language "barriers" become an excuse for staff to separate by ethnicity/language when possible during work sessions and breaks. Employees and supervisors also form teams limited to people from their category. I have even come across a conflict where expatriates chose to use different languages to write their job-sheet handover notes, with the team on one shift writing something in the technical logbook and the next team unable to read what was recorded about task status.

Maintenance technicians often face unfamiliar standards. This occurs although most of the aircraft now maintained in Nigeria are Western-built types. For the maintenance technicians most familiar with Russian airworthiness standards, today's Nigerian standards are significantly different, and their training time reflects this difficulty.

License endorsement/validation processes take too long. All expatriates must have their licenses endorsed or validated by the Nigerian Civil Aviation Authority to be authorized to certify the airworthiness of Nigerian-registered aircraft. Those who have licenses from the U.S. Federal Aviation Administration, however, require additional testing to receive the aircraft type endorsements, a process lasting up to three months or longer.

If maintenance professionals perceive unfairness, resentment can grow into hatred. A Nigerian saying is that two can work together only if they agree. As evidence, I have observed staff sitting down and waiting for a so-called expert from a different category or subcategory to commit errors rather than speaking up or intervening in the interest of safety. With such a strained relationship, there is no safety synergy on the job.

One consequence has been unrest among the labor unions representing maintenance technicians, an issue that today affects most airlines in Nigeria. Sometimes the indigenes become so hostile to their foreign colleagues that their unions demand forced repatriation of some of the staff from foreign countries. Outside the workplace, in the worst cases, societal resentment has been a factor in expatriates and locals being targeted for kidnapping or robbery.

Security concerns work against shared safety culture. A group of expatriate specialists may arrive at work in large cars with security personnel, then after the day's job is completed, security personnel gather them for the drive home. This does not create an avenue for colleagues to interact. If I'm working with somebody who doesn't speak with me, doesn't joke with me, and the only interaction we have is while doing the job together, that does not encourage integration into one society.

So what is the way forward? In my company, we are aiming to create a culture where every employee is part of the system, has a sense of belonging and enjoys peaceful coexistence at work and a sense of safety on the street. We began with a competency matrix and job placement based on merit irrespective of factors such as race, ethnicity or geographical origin.

This means that for every position, there must be a written job description stating the entry requirements in support of equal employment opportunity. My company also has worked with the Nigerian airline entrepreneurs, advising them not only to focus their resources on their expatriate staff for the short term, but also to develop the locals; otherwise entrepreneurs will never see the long-term profits they intended to earn.

Education includes social reorientation for all subcategories of expatriate employees and all subcategories of indigene employees. Education helps locals understand that their counterparts from outside Nigeria are not "enemies" in the workplace. Rather, they fill a temporary vacuum that locals cannot fill yet in some facilities. The expatriates did not cause the infrastructural deficiencies in the country, and they did not come to unfairly exploit their local colleagues or deny them job opportunities.

Wayne Rosenkrans

Amara

Employee consultative forums also have proved valuable for maintenance professionals of all nationalities, races, ethnicities and first languages to regularly get together to socialize, share ideas and understand each other better.

My experience has been that foreigners who mix and relate well with the locals have no reason to fear for their personal security. Life is better when people learn to live and reason together. Envy and hatred, however, pull down even the good structures that already exist.

The global aviation community already has embraced principles of just culture, in which people are encouraged — even rewarded — for providing essential safety-related information, with a clear line that differentiates acceptable from unacceptable professional behavior. Extending these principles to labor relationships can be accomplished by complying with labor laws that ensure equal opportunity and on-the-job training for indigenes to grow in their profession.

For safety, efficiency, effectiveness and harmony, there must be total commitment to change by government, airline management and all aviation stakeholders. If we are all thinking in a productive way, these changes will happen gradually. I know they are not going to happen overnight.

Joshua I. Amara is manager of quality, airworthiness and safety for Nigerian Eagle Airlines and president of Global Flight Safety Organization, a Nigerian affiliate of Flight Safety Foundation.

If maintenance professionals perceive unfairness, resentment can grow into hatred.

Raising the Bar

The new FSF Basic Aviation Risk Standard is designed to help mining and resource companies around the world develop common aviation safety standards.

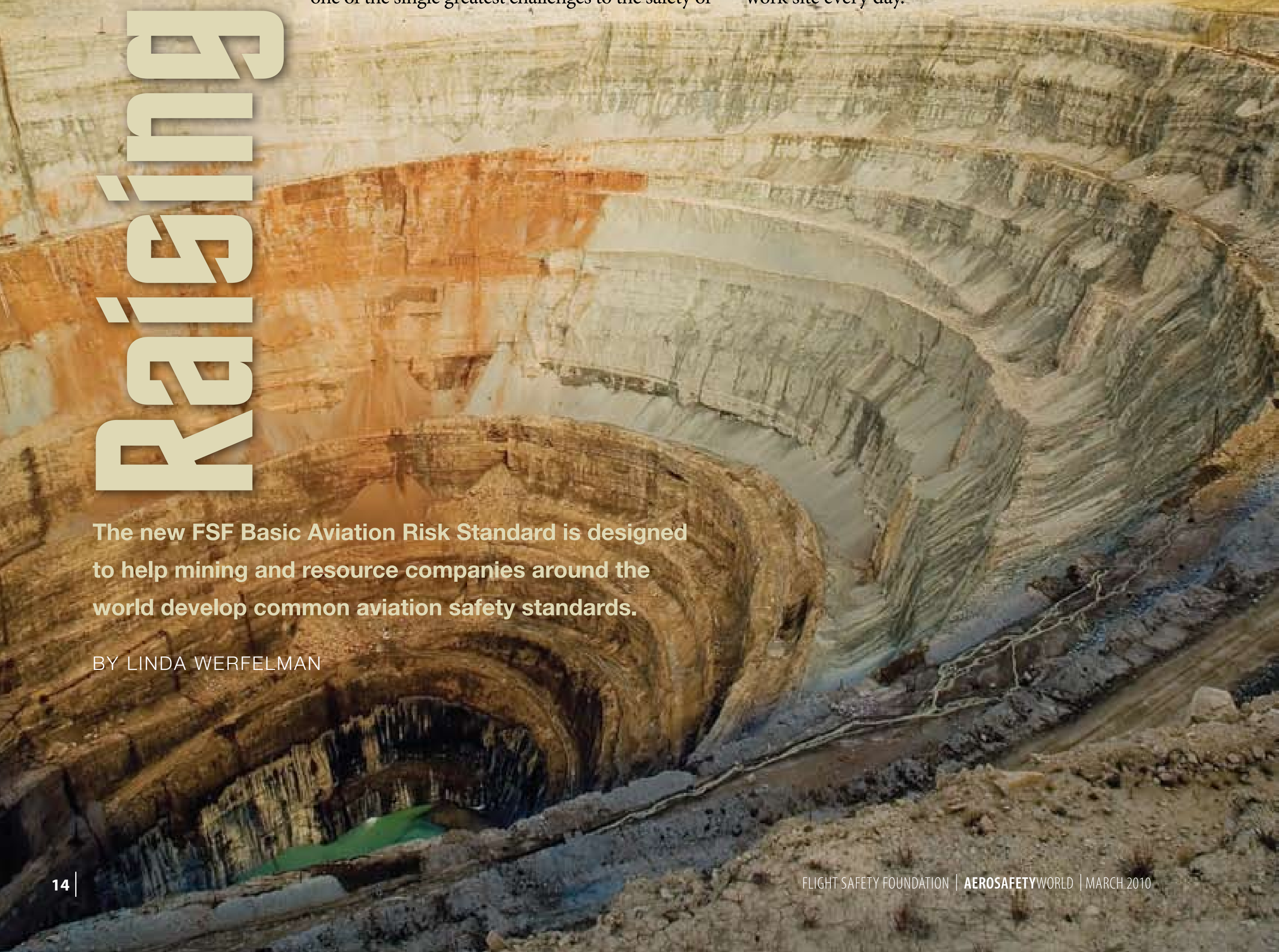
BY LINDA WERFELMAN

Aviation operations associated with the global mining and resource industry make hundreds of flights a day, often under challenging conditions and in areas with inadequate infrastructure, weak regulatory authorities and inconsistent safety standards.

Flight Safety Foundation's new Basic Aviation Risk Standard (BARS) is intended to address the safety issues facing aviation operations in the resource sector — a term that typically encompasses mining and energy companies with operations that are primarily onshore — by establishing common safety standards.[1] The BARS program also has attracted attention from others outside the resource sector, notably the United Nations World Food Program, which uses many of the same aircraft operators.

"Aviation risk management has always been one of the single greatest challenges to the safety of personnel in the resource sector," said FSF International Program Director Trevor Jensen, manager of the BARS program. "Combined with the challenging and often remote areas of operations, additional variables increase the difficulty, including the variety of aircraft types, adverse weather and terrain, wide number of aircraft operators and differing levels of regulatory oversight."

Mining and resource companies use aircraft — from single-engine airplanes and helicopters to airliners — in a wide range of activities, including transportation of workers to remote mining operations, geological surveys, helicopter external load flights, photographic missions and medical evacuation flights. Although many operations are small, others are substantial, Jensen said, citing one operator in Western Canada that uses a Boeing 737 to fly 1,000 employees to a remote work site every day.



The absence of common safety standards for aviation operators under contract to resource companies has troubled many in the resource sector for years, Flight Safety Foundation said when BARS was introduced in February.

"The variety of safety standards among aviation providers and resource companies has been a concern for the industry," the Foundation said. "Before the BARS program, there were no clear industry benchmarks for resource companies when assessing the safety of contracted aviation activity."

As a result, aircraft operators often were subjected to multiple audits that emphasized different sets of standards. Even though the audits often were conducted by the same auditors, the resulting data were not shared.

Accident and incident data for aviation operations associated with the resource sector are incomplete, and it is impossible to determine accident rates for the sector. Compilation of data gathered through the BARS program eventually will make possible that sort of analysis.

Beginnings

Paul Fox, FSF regional director in Melbourne, Victoria, Australia, said the BARS program developed from his conversations early in 2009 with safety officials of BHP Billiton, one of the world's major producers and suppliers of coal, iron ore, oil and gas, and other resources. The conversations centered on the resource sector's need for a single consistent set of safety standards, and a corresponding audit procedure.

BHP Billiton and other leading resource companies — Lihir Gold, Minerals and Metals Group (MMG), Rio Tinto and Xstrata — were among the earliest participants in the new program, Fox added. He said that BARS provides the standardization and consistency of audits that the sector had sought, along with the elimination of unnecessary multiple audits, quality assurance of the audit process, cost efficiency, a centralized accident/incident database and a process to ensure that the industry standards reflect "the evolution of regulations, best practices and identified needs of the sector."

David Jenkins, BHP Billiton vice president for health and safety, praised the program for its "potential to deliver a step-change improvement in global flight safety standards" in the resource industry aircraft operations.

"Flying remains one of the few activities we all undertake which has the potential for double-digit fatalities from a single event," he said in an August 2009 letter to industry colleagues. He noted that in 2008 and early 2009, the resource sector experienced major accidents involving helicopters in minerals and petroleum operations, adding that the BARS program represents a "unique opportunity" to prevent such accidents in the future.

The program also has received the endorsement of the Minerals Council of Australia, which passed a resolution in December 2009 encouraging adoption of BARS by aircraft operators that serve that nation's resource sector.

The program also has stirred interest among relief organizations such as the U.N. World Food Program, and peacekeeping groups, which contract with many of the same aircraft operators that serve the resource sector.

In many countries, especially developing nations in Africa, Asia and South America, the companies that provide these aviation services are "a segment of the industry that's neglected by the regulators," said Foundation President William R. Voss. "These operations are not a high priority in many countries."

Although many operators might receive safety audits through the International Business Aviation Council's International Standard for Business Aircraft Operations (IS-BAO), the BARS audit "goes a little bit deeper" to address all threats in their operations, Voss said.

He added that the BARS program represents a major change for the resource sector.

"A major weakness of the old company-specific standards was that they tended to be prescriptive and reactive to incidents," Voss said. "The BARS program, on the other hand, is based on leading aviation industry risk management principles — analyzing possible points of failure and preparing for them.

"Global demand for a standardized risk-management approach has been high in recent years, but it required an independent organization to manage it. Flight Safety Foundation has stepped into that role. Collaborating with industry leaders, we have created a solid standard that anticipates the risks rather than reacts to them, and can be applied to each company's aviation operations easily and cost-effectively."

Jensen described the four components of the BARS program: the standard; training the "aviation coordinators" — employees of the resource companies whose jobs include aviation-related responsibilities, even though they may have no experience in aviation; the audit program; and the development of a central database that can be analyzed to identify safety trends.

Flight Safety Foundation's role has included publishing and updating the standard. Other companies have been selected to develop training for aviation coordinators and for auditors, who must complete BARS auditor training, pass their exams with a grade of at least 90 percent and conduct at least one audit under an evaluator's supervision before becoming qualified. Jensen describes one of the Foundation's roles as to act as the "auditor of the auditors," overseeing their work.

Safety Culture

The Foundation said that the resource sector and its individual companies have for years had a strong safety culture. One element of that culture has been the frequent use of safety audits. That frequency, however, has itself presented problems, Jensen said.

Because of the absence of a single set of standards applied to the entire sector, individual resource companies adopted their own standards and applied them to the aircraft operators that worked for them.

These multiple standards have resulted in multiple safety audits each year. During each audit, some aviation personnel are diverted from their regular duties to concentrate on the audit, Fox said, noting for some operators, audit time amounts to as many as 28 days a year.

As examples, the Foundation cited the case of one unnamed helicopter operator that experienced 14 separate audits in one year, five of which were conducted by the same audit company. An airplane operator experienced 11 audits, conducted by three separate audit companies, the Foundation said.

"Multiple audits are unnecessary, expensive and time consuming," the Foundation said. "They neither enhance safety levels nor reduce risk."

The resource companies participating in the BARS program have "a strong commitment to and an immediate need for" the program, the Foundation said, noting that the need is "driven by the individual corporate objectives of the companies in respect [to] occupational safety and health, as reflected in their commitment to a 'zero harm' policy for all employees and their requirement to lower exposure to aviation risk."

Program Goals

Goals of the BARS program include creation of a single set of aviation safety standards for the resource sector and a single audit — the BARS Quality Controlled Audit — to ensure that the standards are being met.

Precedents exist for the use of a single industry standard for aviation operations. For example, the International Association of Oil and Gas Producers and the International Airborne Geophysics Safety Association each have their own sets of aviation safety guidelines. The Foundation said that national aviation authorities, in an approach consistent with recommendations from the International Civil Aviation Organization (ICAO), typically expect industry sectors to exercise "a greater responsibility for the day-to-day administration of their industry and its routine surveillance."

The BAR standards are not intended to override the requirements of regulatory authorities, manufacturers or individual companies, "except to the extent that the standards requirement is higher," the Foundation said. "All the standards are descriptive — versus prescriptive — of *what* is required rather than *how* the end is to be achieved."

If there are differences among ICAO requirements, national regulations, BARS and other specific requirements, the highest standard always applies.

Threats and Controls

The BARS program outlines 15 "common controls" that address all threats discussed in the overall standard, including that only appropriately licensed aircraft operators that have been "reviewed and endorsed for use by a competent aviation specialist" should conduct flights for resource companies.

Another control specifies minimum experience requirements for flight crewmembers, which vary according to the size of the airplane and the crewmember's role as pilot-in-command

(PIC) or copilot. For example, the document says that the PIC of a multi-engine aircraft weighing 5,700 kg (12,566 lb) or more should hold an airline transport pilot license (ATPL) and have at least 3,000 flight hours, including 2,500 hours as PIC and at least 500 hours as PIC in multi-engine aircraft. The copilot should have at least 500 flight hours, including 100 hours of multi-engine time and 50 hours in type, and a commercial pilot license.

Crewmembers in all aircraft being flown for resource companies should have at least 50 flight hours, including 10 hours in type, in the previous 90 days and at least three night takeoffs and landings. All flight crewmembers should receive training every two years in crew resource management and aeronautical decision making, and they should have at least one year of experience in a topographical area similar to that where they will work. They also should have "two years accident-free for human error causes, subject to review by the resource company," the document says.

Crewmembers also should receive the annual recurrent training specified by the appropriate civil aviation authorities, with at least one flight check every six months for those who work in "long-term contracted operations," the document says. Training should include weather-related issues. In addition, before a crewmember begins flight duties in a new location on long-term contract, he or she should receive a documented line check that includes orientation to the local procedures and environment.

The document includes similar requirements for maintenance personnel. For example, a chief engineer (maintenance technician) should have at least five years of experience, and a line engineer, at least two years; both should have an engine/airframe/avionics rating, when appropriate, and both should have no record of involvement in a human-error accident for at least the previous two years.

Recurrent training must be provided by the operator or maintenance service provider at least every three years, and should include discussion of human factors and company maintenance documentation and procedures.

Another of the document's common controls specifies a basic minimum equipment list — including a terrain awareness and warning system (TAWS) and a traffic alert and collision avoidance system (TCAS) — for all aircraft used in resource company operations.

Other controls require aircraft operators to institute drug and alcohol policies and flight and duty time limits for flight crewmembers (Table 1, p. 18).

According to these controls, a pilot in a single-pilot operation should fly no more than eight hours a day and 40 hours in any period of seven consecutive days, and a pilot in a two-member crew should fly no more than 10 hours a day and 45 hours in seven consecutive days. Duty days for flight crewmembers must be no longer than 14 hours, the controls say, although fatigue management programs may be used instead of these limits if the fatigue management program has been approved by the regulatory authority.

Maintenance personnel also should be subject to duty time limits, in accordance with a fatigue management program designed to "limit the effects of acute and chronic fatigue," the controls said.

Other controls call on all aircraft operators to conduct an operational risk assessment before beginning operations for "any new or existing aviation activity," and to implement a safety management system, including a provision to require an aircraft operator to notify the resource company of any "incident, accident or non-standard occurrence related to the services provided to the company that has, or potentially has, disrupted operations or jeopardized safety."

The last of the two common controls discuss issues involving

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Flight Time Limits	
Single Pilot	**Dual Pilot**
8 hours daily flight time	10 hours daily flight time
40 hours in any 7-day consecutive period	45 hours in any 7-day consecutive period
100 hours in any 28-day consecutive period	120 hours in any 28-day consecutive period
1,000 hours in any 365-day consecutive period	1,200 hours in any 365-day consecutive period
Source: Flight Safety Foundation	

Table 1

helicopters engaged in external load and offshore operations, and airborne geophysical operations.

Specifics

BARS also examines nine specific types of threats to aviation safety: runway excursions, fuel exhaustion, fuel contamination, controlled flight into terrain, incorrect loading, collision on ground, collision in air, structural or mechanical failure, and weather. In each category, the discussion also includes controls that can be implemented to prevent accidents.

For example, runway excursions can be addressed through six categories of controls, including design considerations in the construction of an airport or helipad to be used in resource company flight operations (Figure 1).

Another control says that company-owned or company-operated airports and helipads should be subject to an operational control and safety review by qualified specialists at least once a year, and landing sites should be assessed before the start of operations.

In addition, the controls call for all multi-engine airplanes to "meet balanced field requirements so that following an engine failure on takeoff, the aircraft will be able to stop on the remaining runway and stop-way, or continue (using the remaining runway and clearway) and climb achieving a net climb gradient greater than the takeoff path obstacle gradient."

Crews of multi-engine airplanes without appropriate performance charts should limit their payload to ensure that, in case of an engine failure after the airplane reaches best rate of climb airspeed, "the net takeoff path clears obstacles by 35 ft up to a height of 1,500 ft" above the airport with the landing gear and flaps retracted and the propeller feathered on the inoperative engine.

Flight crewmembers also must have a means of obtaining accurate weather information at company-owned or company-operated airports, the document says.

Accident Defenses

The BARS program also prescribes defenses that can limit deaths and injuries in case of an accident.

For example, the document says, aircraft that are designed and built in accordance with the most recent certification standards have "increased crashworthiness and survivability characteristics."

A carefully developed emergency-response plan, tested annually, can help, along with installation of an aircraft emergency locator transmitter, use of flight-following systems, a survival kit, first aid kit and crash box. Helicopter crewmembers in hostile environments also should wear survival vests equipped with a voice-capable global positioning system emergency position-indicating radio beacon. Safety belts with upper-torso restraints should always be worn, and passengers should dress for the environment over which the aircraft is flown. Sideways seating should be avoided for takeoffs and landings unless shoulder restraints are used.

In addition, aircraft on long-term contract that seat more than nine passengers must be equipped with a cockpit voice recorder and flight data recorder, company-owned or company-operated airports and helipads should have a method of extinguishing a fire, and the contracting company should determine the required level of insurance.

Program Phases

The BARS, published in late 2009 and updated in February, is ready for adoption by companies in the resource sector. Auditor training programs — designed for the large pool of auditors who currently are under contract to individual resource companies — are scheduled to begin in July. Actual audits are expected to begin soon afterward, in the third quarter of 2010, Jensen said, and limited data should be available by the end of the year.

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Note

1. Flight Safety Foundation. *Basic Aviation Risk Standard, Resource Sector*. February 2010. Related sources are the Foundation's *Basic Aviation Risk Standard, Resource Sector* Briefing, Feb. 23, 2010, and the *Executive Committee Recommendation Resource Sector Basic Aviation Risk Standard*, Sept. 1, 2009.

Aviation Risk-Management Controls

Threat	Controls		
Runway Excursions	Airfield Design Airfield Inspections Balanced Field Length	Site Assessments Destination Weather Reporting	
Fuel Exhaustion	Fuel Check Weather data Flight Plan	IFR Fuel Plan VFR Fuel Plan Hot refueling	
Fuel Contamination	Fuel Testing Fuel Filtration Fuel Sampling	Fuel Storage	Drummed Fuel
Controlled Flight Into Terrain (CFIT)	Night/IFR Two Crew Simulator Training IFR Flight Plan Approach/landing recency	Stabilized Approaches Go-around Procedures CRM/ADM Training	Special VFR Flight Data Monitoring Autopilot TAWS
Incorrect Loading	Passenger Weights Cargo Weights Weight and Balance Calculations	Manifest Dangerous Goods	Passenger Briefing Multi-language Briefing
Collision on Ground	Passenger Terminal Designated Freight Area Passenger Control Ground Procedures	Rotors Running Load/Unload Parking Apron Perimeter Fence	Airfield Control
Collision in Air	Cruising Altitudes Radar Controlled Airspace	Airfield Bird Control	TCAS High Intensity Strobe Lights
Structural/ Mechanical Failure	Single-Engine Multi-Engine Spare Parts Supply Hangar Facilities	Helicopter Vibration Monitoring Engine Trend Monitoring	Minimum Equipment List (MEL) Sub-chartering aircraft
Weather	Adverse Weather Policy Wind Shear Training	VFR Minimums Cold Weather Training Thunderstorm Avoidance Weather Radar	

CRM/ADM = crew resource management/aeronautical decision making; IFR = instrument flight rules;
TAWS = terrain awareness and warning system; TCAS = traffic alert and collision avoidance system; VFR = visual flight rules

Source: Flight Safety Foundation

Figure 1

Fatigue was a likely factor in the crash of this Q400.

BY MARK LACAGNINA

The captain's inappropriate response to a stick shaker activation was the probable cause of an unrecoverable stall and the crash of a Colgan Air Bombardier Q400 on approach to Buffalo Niagara (New York, U.S.) International Airport the night of Feb. 12, 2009, according to the U.S. National Transportation Safety Board (NTSB).

All 45 passengers and four crewmembers in the airplane, plus one person on the ground, were killed, and the airplane was destroyed when it struck a house in Clarence Center, New York, about 5 nm (9 km) northeast of the airport.

In its final report on the accident, NTSB said that the captain caused the airplane to stall by pulling on his control column when the stick shaker activated at an artificially high airspeed — a reaction that was consistent with "startle and confusion" rather than with his training.

The report said that factors contributing to the accident were "the flight crew's failure to monitor airspeed in relation to the rising position of the low-speed cue [on their primary flight displays], the flight crew's failure to adhere to sterile cockpit procedures,[1] the captain's failure to effectively manage the flight, and Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions."

Fatigue also was a likely factor, but investigators could not determine conclusively the extent to which the pilots were impaired by fatigue or how it might have contributed to their "performance deficiencies" during the flight, the report said.

Flight 3407 Crew

The airplane was being operated as Continental Connection Flight 3407 to Buffalo from Liberty International Airport in Newark, New Jersey, the pilots' home base.

The captain, 47, had 3,379 flight hours, including 3,051 hours in turbine airplanes and 111

STARTLED AND CONFUSED

A bad reaction to a stick shaker triggered a stall.

© Michael Fast/Airliners.net

hours in type. He was a Beech 1900D first officer for Gulfstream International Airlines before being hired by Colgan in September 2005.

He received a DHC-8 type rating — a rating common for the Q400 and its predecessors — in November 2008. "The check airman who provided the captain with his IOE [initial operating experience] described the captain's performance as good and indicated that his greatest strength was being methodical and meticulous," the report said.

Q400 first officers who flew with the captain described him as competent. "These first officers also indicated that the captain created a relaxed atmosphere in the cockpit but adhered to the sterile cockpit rule," the report said.

The report pointed out, however, that U.S. Federal Aviation Administration (FAA) records showed that the pilot had not passed initial flight checks for an instrument rating in 1991, a commercial license for single-engine airplanes in 2002, a commercial license for multiengine airplanes in 2004, and an airline transport pilot license in 2007, while at Colgan.

In addition, Colgan's training records showed that the captain had to be retested on normal and abnormal procedures for a Saab 340 first officer check ride in 2006 and had received unsatisfactory grades for a 340 recurrent proficiency check in 2006 and a 340 upgrade proficiency check in 2007.

"The captain had not established a good foundation of attitude instrument flying skills early in his career," the report said. "His continued weaknesses in basic aircraft control and instrument flying were not identified and adequately addressed."

The first officer, 24, worked as a flight instructor in piston airplanes before joining Colgan in January 2008 and received a DHC-8 second-in-command type rating in March 2008. She had 2,244 flight hours, including 774 hours in type.

One captain who had flown with the first officer rated her as average to above average for her level of experience. "Other captains indicated that, because of her abilities, the first officer could have upgraded to captain," the report said.

Commuting Pilots

The report characterized the flight crew as "commuting pilots." The captain commuted to Newark from his home in Tampa, Florida; the first officer commuted from Seattle.

The captain had told another pilot that he wanted to get a "crash pad" near Newark but was trying to avoid the expense of temporary lodging by bidding trips with overnights in hotels or ending at locations with an easy commute home.

The first officer also tried to bid trips that would facilitate her commute.

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Both pilots often slept in the Colgan crew room at Liberty International. The crew room had couches, recliners and a television. The airline's regional chief pilot said, however, that the crew room was intended as a place for crewmembers to relax and that it was not adequate for rest between trips.

The captain had commuted by airline to Newark three days before the accident and had rested in hotels during overnight trips.

The first officer had arrived in Newark the morning before the accident. The night before, she had occupied the jump seat of a cargo airplane that departed from Seattle at 1951 local time and arrived in Memphis, Tennessee, at 2330 Seattle time, or 0230 Newark time. She slept for 90 minutes during the flight. "The captain [of the cargo airplane] stated that she seemed to be alert, well rested and in a good mood, and that she did not show any symptoms of being sick," the report said.

She then flew aboard another cargo airplane that departed from Memphis at 0418 and arrived in Newark at 0623. "According to the captain of this flight, after the airplane landed the first officer told him that she had slept during the entire flight," the report said. "The captain also stated that he asked her what she would be doing until her report time and that she responded that one of the couches in the crew room 'had her name on it.' [He] stated that she did not appear to be tired and showed no symptoms of being sick."

Both accident pilots were seen in the Colgan crew room before their scheduled report time of 1330.

First Flights Canceled

High winds and ground delays at Newark that afternoon prompted the cancellation of several Colgan flights, including the flight crew's first two scheduled flights — to Rochester, New York, and return. The estimated departure time for Flight 3407 to Buffalo was 1917.

The captain spent the afternoon doing office work — inserting revisions in airplane manuals — and relaxing in the crew room.

"The first officer's specific activities on the day of the accident are not known, but several pilots reported seeing the first officer in the crew room watching television, talking with other pilots and sleeping," the report said.

The cockpit voice recorder (CVR) picked up several sounds of the first officer sneezing and sniffling. While waiting for takeoff clearance, she told the captain, "I'm ready to be in the hotel room. This is one of those times that, if I felt like this at home, there's no way I would have come all the way out here. … If I call in sick now, I've got to put myself in a hotel until I feel better. … We'll see how it feels flying. If the pressure's just too much I could always call in tomorrow — at least I'm in a hotel on the company's buck — but we'll see. I'm pretty tough."

The report concluded, however, that the first officer's illness likely did not directly affect her performance during the flight.

Deicing Equipment On

The crew received takeoff clearance at 2118 and activated the propeller and airframe deicing equipment while climbing to their assigned cruise altitude, 16,000 ft.

"The cruise portion of flight was routine and uneventful," the report said. "The CVR recorded the captain and the first officer engaged in an almost continuous conversation, but these conversations did not conflict with the sterile cockpit rule."

Weather conditions at Buffalo included surface winds from 240 degrees at 15 kt, gusting to 22 kt, 3 mi (4,800 m) visibility in light snow and mist, a few clouds at 1,100 ft, a broken ceiling at 2,100 ft and an overcast at 2,700 ft.

At 2156, the first officer said, "Might be easier on my ears if we start going down sooner." On the captain's instructions, she requested clearance to descend. The Cleveland Center controller cleared the crew to descend to 11,000 ft.

The crew established radio communication with Buffalo Approach Control at 2203 and were told to expect the instrument landing system (ILS) approach to Runway 23. They briefed for the approach and calculated a reference landing speed (V_{REF}) of 118 kt.

Bombardier Aerospace Q400

The Bombardier Q400 is the latest in the line of DHC-8, or Dash 8, commercial twin-turboprops launched by de Havilland Canada in 1980. The Q400 entered service in 2000 with a stretched fuselage and seating for up to 78 passengers.

The airplane has Pratt & Whitney Canada PW150A engines, each flat-rated to 5,070 shp (3,782 kW), and Dowty R408 six-blade composite propellers that turn at 1,020 rpm for takeoff and 850 rpm for cruise. Maximum fuel capacity is 1,724 gal (6,526 L).

Maximum weights are 64,500 lb (29,257 kg) for takeoff and 61,750 lb (28,010 kg) for landing. Sea-level field lengths at the maximum weights are 4,265 ft (1,300 m) for takeoff and 4,223 ft (1,287 m) for landing. Maximum cruising speed is 360 kt. Maximum altitude is 25,000 ft, and service ceiling with one engine out is 17,500 ft. Maximum range with 70 passengers and reserves is 1,360 nm (2,519 km).

Source: *Jane's All the World's Aircraft*

© Gerry Hill/Airliners.net

Reference Speed Riddle

The crew set the V_{REF} "bugs" on their airspeed indicators to 118 kt. This value was appropriate for an uncontaminated airplane. However, when the crew activated the deicing equipment during departure from Newark, they also set the "REF SPEEDS" switch on the ice-protection panel to "INCR" (increase).

This action is required by the Q400 airplane flight manual (AFM) before entering icing conditions and results in activation of the stick shaker at a lower angle-of-attack — thus, at a higher airspeed. The AFM also specifies that on approach, the flight crew must increase V_{REF} by 15 to 25 kt, depending on flap setting, to remain above the stall-warning threshold.

Colgan's company flight manual for the Q400, however, provided inadequate guidance for the use of the "REF SPEEDS" switch and did not require crews to cross-check the switch position against their V_{REF} bugs on approach, the report said.

The result during the approach to Buffalo was that the stick shaker activated about 13 kt higher than the V_{REF} value set by the crew.

Unsterile Cockpit

The approach controller cleared the crew to 6,000 ft, and the Q400 descended through 10,000 ft at 2206. "From that point on, the flight crew was required to observe the sterile cockpit rule," the report said.

The crew received further descent clearance to 4,000 ft.

At 2210, the captain said that there was ice on his side of the windshield and asked the first officer if there was ice on her side. "Lots of ice," she replied.

The captain then said, "That's the most … ice I've seen on the leading edges in a long time — in a while anyway, I should say."

Despite these statements, the report said that recorded flight data showed the ice accumulation had a minimal effect on the airplane's performance and did not affect the crew's ability to fly and control the airplane.

The pilots continued their conversation about previous experiences in icing conditions. "During that conversation, the first officer indicated that she had accumulated more actual flight time in icing conditions on her first day of [IOE] with Colgan than she had before her employment with the company," the report said.

At 2212, the approach controller cleared the crew to descend to 2,300 ft, the initial approach altitude. "Afterward, the captain and the first officer performed flight-related duties but also continued the conversation that was unrelated to their flying duties," the report said.

The crew conducted the descent and approach checklists while being vectored to the final approach course, 233 degrees.

The maximum allowable approach speed was 138 kt, but airspeed was 184 kt when the crew was cleared for the approach about 3 nm (6 km) from the outer marker. "The captain slowed the airplane by extending flaps to 5 degrees, reducing power to near idle, extending the landing gear and moving the condition levers to maximum rpm," the report said.

At 2216, the approach controller told the crew to establish radio communication with the Buffalo airport traffic controller. The first officer's acknowledgement of the instruction was the last communication between the crew and air traffic control.

Missed Cues

Neither pilot responded to cues of an impending stall warning. Among the cues were indications on the primary flight displays (PFDs) of an excessive nose-up pitch attitude.

Other cues were provided by the airspeed data on the PFDs. Each display has a vertical airspeed scale with a trend vector, a white arrow, that indicates increasing or decreasing airspeed. The tip of the arrow indicates what the airspeed will be in 10 seconds if the trend continues. The trend vector in Figure 1, for example, shows that airspeed is increasing from 260 kt and will be about 278 kt in 10 seconds.

A red and black vertical bar appears next to the airspeed scale to warn that airspeed is too low. The stick shaker activates when the indicated airspeed drops below the top of the bar. In addition, the displayed airspeed changes from white to red to provide another warning that airspeed is too low.

These low-speed cues were presented on the PFDs "with adequate time for the pilots to initiate corrective action, but neither pilot responded to the presence of these cues," the report said. "The failure of both pilots to detect this situation was the result of a significant breakdown in their monitoring responsibilities and workload management."

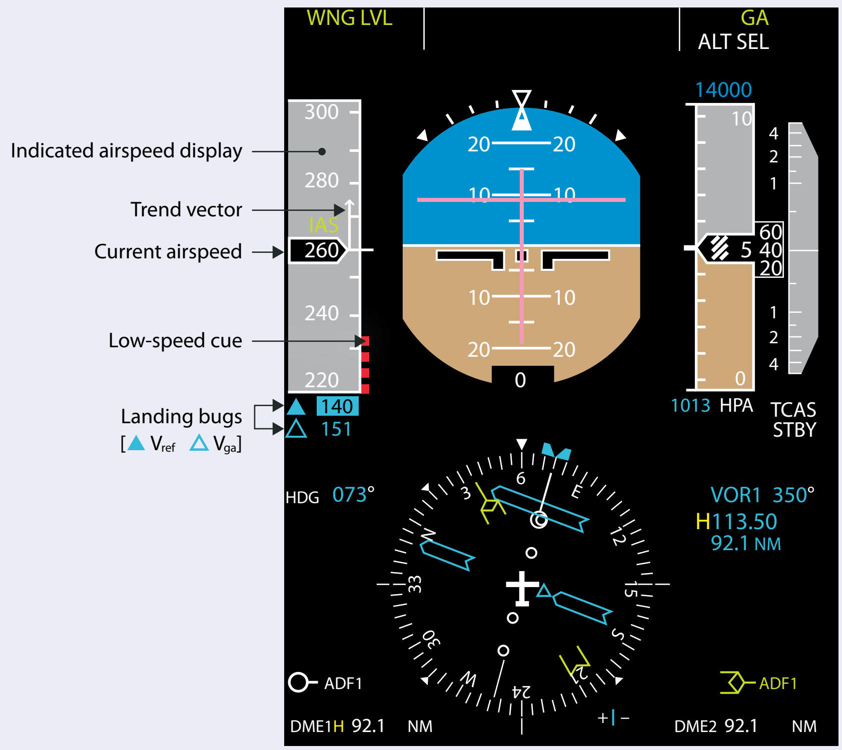
Seconds to Impact

About 20 seconds after the first officer's last radio transmission, the stick shaker activated and the autopilot automatically disengaged. When the stall warning occurred, the landing gear was extended, the flaps were being extended through 10 degrees to 15 degrees, and airspeed was about 131 kt.

"The airplane was not close to stalling at the time," the report said. "However, because the ref speeds switch was selected to the increase (icing conditions) position, the stall warning occurred at an airspeed that was 15 kt higher than would be expected for a Q400 in a clean (no ice accretion) configuration."

Flight data recorder (FDR) data indicated that the captain increased power as he pulled his control column back with 37 lb (17 kg) of force. "The captain's inappropriate aft control column inputs in response to the stick shaker caused the airplane's wing to stall," the report said.[2] Angle-of-attack increased to 13 degrees, load factor increased from 1.0 g to about 1.4 g, and

Q400 Primary Flight Display



V_{ref} = reference landing speed; V_{ga} = go-around speed

Source: U.S. National Transportation Safety Board

Figure 1

airspeed decreased to 125 kt, the stall speed under these conditions.

The airplane rolled left 45 degrees and was rolling back to the right when the stick pusher activated.[3]

Airspeed was 100 kt when the first officer retracted the flaps without consulting the captain. The report said that this action was inconsistent with Colgan's stall-recovery procedures and training.

"The roll angle reached 105 degrees right-wing-down before the airplane began to roll back to the left, and the stick pusher activated a second time," the report said. "FDR data showed that the roll angle had reached about 35 degrees left-wing-down before the airplane began to roll again to the right."

The first officer asked the captain if she should retract the landing gear. The captain replied, "Gear up," and voiced an expletive. "The airplane's pitch and roll angles had reached about 25 degrees airplane-nose-down and 100 degrees right-wing-down, respectively, when the airplane entered a steep descent," the report said.

Among the last sounds recorded by the CVR were the captain saying, "We're down," and the first officer screaming.

The Q400 struck the house about 27 seconds after the first activation of the stick shaker. There was a post-impact fire fed by fuel from the airplane and by natural gas from a severed pipe in the house (see article, p. 26).

Based on the findings of the investigation, NTSB issued 25 recommendations to the FAA. They included leadership training for upgrading captains, fatigue risk management for commuting pilots, and improved stall recognition and recovery training for pilots.

This article is based on NTSB Accident Report NTSB/AAR-10/01, "Loss of Control on Approach; Colgan Air, Inc., Operating as Continental Connection Flight 3407; Bombardier DHC-8-400, N200WQ; Clarence Center, New York, February 12, 2009." The full report is available from the NTSB Web site, <www.ntsb.gov/publictn/2010/AAR1001.pdf>.

Notes

1. *Sterile cockpit procedures* are mandated by U.S. Federal Aviation Regulations Part 121.542(b) and (c), which state: "No flight crewmember may engage in, nor may any pilot-in-command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft. For the purposes of this section, critical phases of flight include all ground operations involving taxi, takeoff and landing, and all other flight operations below 10,000 ft, except cruise flight."

2. The report said that the Q400 is not prone to tailplane stall and that it is unlikely the captain was deliberately attempting to perform a tailplane-stall recovery.

3. The stick pusher activates when stall angle-of-attack has been reached. The report said that it provides a tactile cue to push on the control column to gain airspeed and alleviate the stall condition. The stick pusher also positions the elevator to 2 degrees nose-down.

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Mutual Aid

BY THOMAS CHMIELOWIEC SR.

When the Q400 struck a house and exploded, the volunteer fire chief pulled ARFF specialists into a massive response.

A call from air traffic control (ATC) captured the attention of 10 firefighters on duty at Buffalo Niagara (New York, U.S.) International Airport Fire Department (BNIA-FD). The message for aircraft rescue and fire fighting (ARFF) at about 2220 on Thursday, Feb. 12, 2009, said that a regional turboprop established on the localizer of the Runway 23 instrument landing system could be down somewhere between the outer marker and Harris Hill, near Akron, approximately 12 nm (22 km) northeast of the airport (see p. 20).

All the firefighters went to their trucks, but for about a minute they sat idle in the firehouse with no place to go. That gave them an eerie feeling, listening to their radios as ATC repeatedly called "Colgan 3407" and got no answer. The flight crew of a nearby airliner flying in instrument meteorological conditions had told ATC that the missing aircraft could not be seen visually or on the display of their traffic-alert and collision avoidance system.[1]

Some of the firefighters anticipated the possibility that the aircraft had traveled thousands of feet along the ground and wiped out a neighborhood. They did not know yet that the Colgan Air Bombardier Q400 had struck only one house.

Between one and two minutes after the crash phone rang, one of the firefighters telephoned Amherst Fire Control, the dispatch center for 15 local volunteer fire departments, to find out whether an aircraft was reported down in its districts. The dispatchers said they were being flooded with phone calls, and that they had dispatched Clarence Center Volunteer Fire Company (CCVFC) to a specific address in Clarence Center for a "possible aircraft into structure" call.

Firefighters from 17 fire departments, most volunteers, responded to the scene.

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The firefighter then asked the dispatchers, "Would you like us to start rolling toward that site just in case?" By two minutes after the initial alert from ATC, one of the three BNIA-FD crash trucks — supported by one structural pumper with foam capability and extra hoses — responded with full ARFF crews and a captain. They arrived at the scene 12 minutes later.

So began 11 days of ARFF mutual aid to various stages of firefighting, crash site recovery and accident investigation in Clarence Center, a village surrounded by the Town of Clarence. There probably were some flaws somewhere along the line, but, at least to me, they were so unnoticeable that I will remember this experience as a picture-perfect firefighting operation by all the fire companies involved.

At BNIA, the full airport emergency plan was put into place. Christopher Putney, fire chief of BNIA-FD, was in command of airport response, ARFF on-scene and off-scene operations and keeping the airport functional during the emergency. With the help of four captains, he safely coordinated crew involvement in all activities, including sending firefighters as standby emergency medical technicians to the center where family members received official information and counseling during the unfolding tragedy.

My crash-related duties began just after midnight at the BNIA-FD firehouse, and my first shift at the scene was Friday 0700–1100 as the captain on the third ARFF relief crew. My understanding of the firefighting response reflects personal experience; published accounts from a few key participants such as David Case, then chief of the CCVFC and incident commander, and Timothy Norris, the assistant chief and first firefighter to reach the crash site; findings of the U.S. National Transportation Safety Board (NTSB); and recorded ATC and fire service radio communications.

First Arrivals

This event happened on Long Street just 525 ft (160 m) from the CCVFC firehouse, shortly after a few firefighters had returned from an emergency medical services call. BNIA weather conditions included near-freezing temperature, winds west–southwest at 14 mph (23 kph) with light snow and mist, the NTSB said.

From inside their own houses, Norris and Case heard a loud but muffled impact of the aircraft with the house. Running outside, they heard an explosion and saw a fireball.[2,3] Seconds later, at 2219, their signal emitters sounded with the alarm from Amherst Fire Control, Case recalled.

Norris drove his fire command truck three blocks from his house to the location in about 15 seconds, and Case arrived in his fire command car after driving about 0.5 mi (1 km) from his house as a wall of flames about 60 to 70 ft (18 to 21 m) high lit up the village.

Fire Departments Respond to Colgan Air Flight 3407

Fire Incident Command, Communication and Documentation

AFCD = Amherst Fire Control (Dispatcher)
CCVFC = Clarence Center Volunteer Fire Company
EC-EOC = Erie County Emergency Operations Center
EC-MCC = Erie County Mobile Command Center (Clarence Town Hall)

Mutual Aid Fire Departments
(Fire, emergency medical services, hazardous materials and/or scene recovery)

AFC = Akron Fire Company
BFD = Buffalo Fire Department
BFD5 = Brighton Fire District No. 5
BNIA-FD = Buffalo Niagara International Airport Fire Department
BVFC = Bowmansville Volunteer Fire Company
CFD = Clarence Fire District No. 1
EAFD = East Amherst Fire Department
GFC = Getzville Fire Company
HHVFC = Harris Hill Volunteer Fire Company
LVAC = Lancaster Volunteer Ambulance Corps
MTFC = Main Transit Fire Company
MVFD = Millgrove Volunteer Fire Department
NAFD = North Amherst Fire Department
NFAFRS = Niagara Falls Air Force Reserve Station
NFC = Newstead Fire Company
OFPC = Office of Fire Prevention and Control (New York)
RMMS = Rural/Metro Medical Services
RVFC = Rapids Volunteer Fire Company
SFC = Swormville Fire Company
TCA = Twin City Ambulance

Sources: U.S. National Transportation Safety Board, David Case, Thomas Chmielowiec Sr.

Figure 1

While driving to the location, Case asked Amherst Fire Control to dispatch heavy rescue vehicles from two nearby volunteer fire companies with full crews, a water-cascade system and shoring materials to support search and rescue (Figure 1).

The aircraft fuel tanks were ruptured by the impact, and burning Jet A fuel was concentrated in the basement of the crushed house. Burning natural gas from a household meter broken in half — with its valve left in the full-open position — also fueled the flames, thick smoke and radiant heat. The flames were going straight up; the wind was not a factor.

The fire area was confined to part of the residential lot. Firefighters ordered the shutdown of all utilities as part of their standard operating procedures, yet a continuing flow of natural gas feeding the fire was not recognized for a while.

The fire chief and assistant fire chief sized up the situation, including the protruding aircraft vertical stabilizer, and confirmed on Amherst Fire Control's designated radio channel for on-scene operations that a relatively large airplane had struck the house, and the house was fully involved. BNIA-FD simultaneously got this information by telephone from Amherst Fire Control, and confirmed the crash and its location to ATC.

Fast Attack

Some firefighters who arrived with the first CCVFC and mutual aid fire engines were assigned to do a systematic 360-degree perimeter check, searching and listening for any sound of survivors,[4] as close to the fire as possible and in surrounding areas including trees and roofs. Other CCVFC firefighters simultaneously laid in about four or five 1.75-in (4.45-cm) hoses and established a water supply from a hydrant in front of their firehouse. Unlike most calls in which firefighters can don their standard structural turnout gear — that is, protective clothing — and self-contained breathing apparatus (SCBA) en route, the first-arriving CCVFC firefighters did this while on scene. The first mutual aid fire company to arrive also established a water supply from a second hydrant near the house.

"After crews searched the entire area, it was finally determined there were no survivors," Case recalled. Around this time, he requested one crash truck from BNIA-FD to help extinguish the fire with aqueous film-forming foam and the Erie County mobile command unit. The two ARFF crews already were en route, however.

"We quickly refocused our attention to fire-suppression operations as we started to gain headway," Case said. "The Erie County mobile command unit arrived. Inside the command post, we tried to determine how many people were on the plane and the quantity of fuel. Originally, we thought just a crew was bringing the plane in." He learned from emergency medical technicians that two of the three occupants of the house had escaped and survived.

The wood-frame house struck by the airplane initially was destroyed by the impact forces, not fire, and two vehicles burned next to it. Because curtains of water from deluge and blitz guns quickly were applied, the garage building behind the house and the brick house 20 ft (6 m) to the north never caught fire, despite exposure to radiant heat from approximately 5,800 lb (2,631 kg) of burning fuel. At the brick house, there was heat damage, such as the plastic globe of the electric meter and vinyl electric-service entrance cable melting, and minor damage from flying debris.

The crash truck, equipped with a roof turret operated from the cab, had a capacity of 3,000 gal (11,356 L) of water and 412 gal (1,560 L) of foam concentrate. This water tank can be refilled four times with water before exhausting one tank of foam concentrate. The pumper, equipped with a bumper turret operated from the cab, carried 750 gal (2,839 L) of water and 90 gal (341 L) of foam concentrate. ARFF personnel reported that the bulk of the early fire extinguishment took approximately 90 minutes.

Natural Gas Threats

The NTSB determined that National Fuel Gas, the utility company, was

called at 2358 regarding blowing and burning gas, and its crew arrived on scene Friday at 0033. NTSB said, "The crew shut off the flow of gas at the homes on both sides of the accident site. The crew was initially unable to shut off the flow of gas at the destroyed home because the gas shutoff valve and gas meter were directly in the fire area. About 0130, after National Fuel [Gas] had completed all of the work that it could safely accomplish, the incident commander … requested that the crew retreat from the site."

Gas company officials then determined that a system shutdown affecting about 50 homes would be required to stop the flow of gas at the fire scene. After consulting others about possible evacuation of the residents in the early morning hours and freezing temperatures, the CCVFC fire chief held off on the shutdown, the NTSB said.

When I arrived early Friday morning, I learned that one reason that the overall fire was not yet declared under control was an apparent magnesium fire creating a hot spot underground in the cockpit area. For unknown reasons, it could not be knocked down with foam, water or F-500.[5] My crew came closer with the crash truck and dumped 450 lb (204 kg) of Ansul Purple-K[6] down a vent hole. Each time I would dump some Purple-K down there, the fire would go out. Then a few seconds later, it would erupt again with a "whoosh" sound.

At that point, I told the other firefighters, "We don't just have magnesium down there, we have natural gas." They answered, "A gas company crew was here last night, and we understood they had shut off the gas from the street to the house." I replied, "Then we must have a broken line underground." The incident commander then asked the gas company to do additional work.

In the meantime, a large number of people already were walking on the crash site itself. One of the ARFF firefighters on the crash truck looked at the cab display of images from the roof-mounted infrared camera. He told me, "It's a roaring furnace underground; look what I'm picking up from 10 ft [3 m] down." So I called over representatives from the Federal Aviation Administration (FAA), Federal Bureau of Investigation (FBI) and NTSB. They hopped up in the truck cab to see the display, and I told them, "If I were you, I would pull all of my people off the site. I don't know what's going on here yet but that may be natural gas burning underground." They agreed to leave. "This delayed the NTSB accessing the scene and beginning the investigation," Case recalled.

The NTSB report said, "About 0855, the incident commander allowed National Fuel [Gas] to enter the front yard of the destroyed home to secure the flow of gas at the home, which put out the natural gas fire." This time, while digging up the affected area, the company's crew discovered that a short piece of PVC (polyvinyl chloride plastic) pipe between the main line and the house shutoff valve had been ruptured from the force of the airplane impact. Once they sealed off the pipe, the flame coming out of the vent hole diminished.

Working carefully so as not to disturb too much of the site after gas flow stopped, the ARFF crew noticed another small fire in part of the fuselage near the vent hole. I asked the NTSB investigator-in-charge if we could move this part closer to the road to get a better angle for extinguishment and flood the area. The NTSB agreed, and a highway excavator was brought to the scene to lift up some of the rubble. That small fire and some hot spots were extinguished within 45 minutes.

The relief crew after mine then flooded the area with approximately 9,000 gal (34,069 L) of water to extinguish any debris left burning from the underground fire and saturate the ground. All major firefighting was concluded at that point.

We were advised Friday afternoon by the NTSB that recovery would start Saturday morning. The first crews of the Buffalo Fire Department Rescue 1, Engine 21 and Ladder 6 vehicles arrived then as a specialty team. With ARFF support and under the direction of then-Buffalo Fire Commissioner Michael Lombardo, these crews spent three days helping the NTSB and the Erie County Medical Examiner's Office to separate the human remains, personal effects, wreckage, house and evidence for the accident investigation.

Minor Delay

Looking back at a few issues, the fact that a lot of the Clarence Center streets initially were clogged with other fire equipment meant that the first ARFF crews had difficulties — for about 20 minutes — trying to get the crash truck and support truck to the locations designated by the incident commander. Part of the access problem was temporary mass confusion, with many civilians crowding the area before arriving law enforcement secured the perimeter, began evacuating residents and ordered onlookers to leave.

Given the total fatalities on the aircraft, the destruction of the house and the fire confined to that small area, the time lost was not of much concern. Case later noted that the BNIA-FD firefighters had to communicate on radio frequencies that were incompatible with the six channels implemented by CCVFC and other

David Bissonette, standing, Clarence disaster coordinator; and left-right, Sgt. Bert Dunn, Clarence Police; Scott Bylewski, Clarence town supervisor; and Capt. Steven Nigrelli, New York State Police, speak with news media on Feb. 14, 2009.

volunteer fire companies dispatched by Amherst Fire Control.

Lessons Learned

There really was no time to think about what to do. Everything that firefighters are taught and trained to do kicked in, and CCVFC and mutual aid did the right things automatically.

Whether emergency calls occur on or off the airport, everybody in Western New York's ARFF and volunteer fire companies knows what they have to do because of annual briefings, cross-training and drills. If a crash truck is ever needed, they know how to hook up the crash truck to hydrants, how to do hose layouts and connections, and how to apply foam.

Case, the incident commander, has cited lessons from the overall experience: Firefighters may need drills to prepare for situations involving minimal/no time en route to don turnout gear or mentally rehearse what they will do while riding in their apparatus; even with NTSB assistance, firefighters at times had concerns and difficulty accomplishing both fire control and preservation of the accident scene; the incident commander must ensure absolutely that utilities have been shut off completely; personal relationships developed earlier during joint drills among fire departments are an extremely positive factor under such stressful conditions; and the incident commander sometimes must turn down requests and postpone decisions that can wait.

I concur. Firefighters hear about it if one responding agency doesn't "click" with another. From my personal perspective, we did not have conflicts at this scene. When a problem arose requiring a quick multi-agency decision, the coordinators got together and the problem was rectified — usually in a few seconds.

On this topic, I learned much from how David Bissonette, the disaster coordinator for Clarence, ran the emergency coordination. By 30 minutes after the alarm, he had established the location for the Erie County mobile command center at Clarence Town Hall and the news media staging area, enabling incident command officers to remain focused on scene safety, fire suppression and protecting exposed property from the fire and heat.

To read an enhanced version of this story, go to the FSF Web site <www.flightsafety.org/asw/mar10/flight3407-arff.html>.

Thomas Chmielowiec Sr. retired as a captain in August 2009 after 28 years with the Buffalo Niagara International Airport Fire Department. Wayne Rosenkrans, an ASW *senior editor, assisted in adapting and updating this story from the author's 2009 ARFF Working Group Conference presentation.*

Notes

1. NTSB. *Loss of Control on Approach. Colgan Air, Inc. Operating as Continental Connection Flight 3407, Bombardier DHC-8-400, N200WQ, Clarence Center, New York. February 12, 2009.* Accident Report NTSB/AAR-10/01. Feb. 2, 2010.
2. Case, David. "Response to Crash of Flight 3407." *Fire Engineering.* Aug. 1, 2009.
3. Case, David. Telephone interview for Internet podcast by Bobby Halton, editor-in-chief of *Fire Engineering*, Feb. 16, 2009.
4. The NTSB final report said, "This accident was not survivable. … The Erie County Medical Examiner's Office determined that the cause of death for the airplane occupants and the ground victim was multiple blunt force trauma."
5. Firefighters typically use F-500, produced by Hazard Control Technologies, for fuel fires. Unlike aqueous film-forming foam that deprives a fire of oxygen, F-500 stops combustion with encapsulating micelles, described as "chemical cocoons around the hydrocarbon fuel neutralizing the fuel leg of the fire tetrahedron [the chemical reaction]."
6. Firefighters typically use Ansul Purple-K, a potassium bicarbonate–based dry chemical containing chemical additives, to extinguish burning flammable liquids, gases, greases and/or energized electrical equipment.

BY WAYNE ROSENKRANS

LINE UP AND *Wait*

SMS risk assessments convince the FAA that more of ICAO's ATC clearance procedures and phrases can be adopted safely.

Clashing perspectives of U.S. progress in optimizing air traffic control (ATC) procedures and phraseology to reduce collision risks on airport surfaces emerged in December 2009 during the U.S. Federal Aviation Administration (FAA) International Runway Safety Summit in Washington. Time devoted to this issue paled in comparison to other layers of defense on the agenda (*ASW,* 2/10, p. 14; 9/08, p. 46; 11/07, p. 44). Nevertheless, U.S. National Transportation Safety Board (NTSB) and FAA talking points at the summit suggested that since 2007, a variety of new factors have persuaded the FAA to adopt elements of safety recommendations traceable to accident investigations more than a decade ago.

Deborah Hersman, NTSB chairman, criticized FAA progress in this area as too slow or unfinished. "In July 2000, the NTSB issued six safety recommendations to the FAA[1] … to amend various U.S. ATC procedures that, in the NTSB's judgment, unnecessarily added to the risks associated with airport surface operations," she told summit attendees. "All but one of those six recommendations are still open, with FAA responses in varying states of completion, and the remaining recommendation regarding limitations on the use of 'position and hold' procedures[2] has been [designated] 'closed — unacceptable action' after the FAA declined to make the recommended changes.

"We were recently advised that the FAA soon plans to adopt a single change, the use of 'line up and wait' instead of 'position and hold' to instruct pilots to enter a runway and wait for takeoff clearance. … Some of the FAA's responses [to NTSB safety recommendations] have asked for more time for further analysis."

FAA publications in mid-2009 described pertinent changes in ATC procedures and phraseology at various stages. "[The FAA] conducted a safety risk analysis of explicit taxi clearance instructions, explicit runway crossing clearances, takeoff clearances and multiple landing clearances (including landing clearances too far from the airport)," the agency said. "We published and distributed detailed taxi instructions to the field in May 2008 with implementation through the summer of 2008. … Among related tasks to accomplish are to 'Publish guidance requesting positive clearance to cross any runway — all crossings of any runway must be confirmed via air traffic control clearance.'"[3]

Current FAA Activity

Michael McCormick, FAA director of terminal safety and operations support, explained recent FAA decision making on ATC procedures and phraseology as a panelist during the runway safety summit's closing session. "The first change that went into play [in 2008] was explicit taxi instructions or detailed taxi instructions … to mitigate the risk of aircraft taxiing in the

'Detailed taxi instructions … mitigate the risk of aircraft taxiing in the wrong direction or wrong place.'

wrong direction or wrong place," he said. Input from the Air Traffic Aviation Safety Action Program (ATSAP; *ASW,* 7/09, p. 12) already has prompted reevaluation, however.

"We are reanalyzing [although] we thought we had made a positive change in the system," he said. "If there are unintended consequences now, we need to … look at what additional risks there are and how we mitigate, change or refine that process to make it work for everybody."

The second change, implemented in August 2008, affected ATC clearances after crossing a runway. "[Controllers now] cannot issue a 'cleared for takeoff' clearance until after an aircraft has crossed the active runway and taxied onto the runway from which the aircraft is going to be cleared for takeoff," McCormick said. "That mitigates the [possibility of the pilot] misunderstanding and an aircraft turning onto the wrong runway and actually taking off either in the wrong direction or on the wrong runway. Runways that are less than 1,000 ft [305 m] apart are exempted from that procedure."

The third change, still in the works, would eliminate "taxi to" from ATC taxi instructions. "Controllers will just issue the runway number, and then the instructions on how to get to the runway," he said. "That puts up an automatic 'stop sign' so that pilots can't cross any runways because 'taxi to' … now authorizes the pilot to

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cross all runways and taxiways to get to the runway. When the change is implemented, pilots will have to have a 'green light' [an explicit clearance] before they can cross any runways."

The fourth change, still in development, affects how ATC manages multiple runway crossings. "Controllers can only issue a clearance across one runway at a time, and then once the aircraft is clear of that runway, the pilot will be issued a clearance across the next runway," McCormick said. "[This] would preclude pilots misunderstanding that they have been cleared to cross all intervening runways."

The third and fourth changes have been cleared by the FAA Air Traffic Organization's Safety Risk Management Decision (SRMD) Panel, and final approval has been requested. The SRMD Panel had to resolve concerns about injecting more risk into the existing ATC system, McCormick said. Examples of risks to accept or mitigate were multiple pilot-controller communications and additional coordination between the tower local controller and the ground controller. "After the pilot clears a runway, and is going to be cleared onto the next runway, that requires another series of communications between a pilot and a controller, which increases the opportunity for an incorrect clearance or an incorrect readback," he explained.

To implement "line up and wait" in the United States, the question of how to change the habits acquired by all U.S. controllers and pilots became significant. "It probably took me just about a week of feeling uncomfortable to get used to this phrase [taxiing in countries that use 'line up and wait']," McCormick said. "However, this is a dramatic change for the entire workforce of [15,000] U.S. controllers and the flight crews that will need to adjust."

As of December 2009, "line up and wait" was in the post-SRMD Panel stage. "[FAA] document change proposals are already drafted, procedures already have been drawn up, and we are waiting for the final approval," he said. "Once that is done, we are going to kick off at least a 150-day training period."

ICAO Audit Influence

In 2008, the International Civil Aviation Organization (ICAO) audit of the U.S. civil aviation system found that although the FAA Air Traffic Organization had a runway safety program, a safety management system (SMS) would not be fully implemented until March 2010.[4] Concerning the program, the audit finding said that a number of provisions in ICAO standards for readback of clearances and procedures for aerodrome control service had not been incorporated into this runway safety program but could "form part of effective runway incursion prevention measures."

The audit finding added, "The FAA should revise its runway safety program to: require readback of clearances in accordance with ICAO Annex 1 [*ICAO Standards,* 11.3.7.3]; apply clearances to land in accordance with *Procedures for Air Navigation Services–Air Traffic Management [PANS–ATM]* Chapter 7 ['Procedures for aerodrome control service,' 7.9.2]; apply the phraseologies for taxiing aircraft in accordance with *PANS-ATM* Chapter 12 ['Phraseologies,' 12.3.4.7 through 12.3.4.10]; and [require] explicit clearances to cross or hold short of a runway when a taxi clearance contains a taxi limit beyond the runway in accordance with … *PANS–ATM* Chapter 7 [7.5.3.1.1.2]."

The FAA's corrective action plan in response to the audit finding also said, "Currently, FAA is in the process of completing a safety risk management document … to explicitly require clearances to cross runways." The plan to establish safety risk management work groups by November 2008 was accepted by ICAO.

Long Evolution

The February 2010 edition of its *Most Wanted* list indicates that the NTSB still urgently wants the FAA to "require specific [ATC] clearance for each runway crossing" after more than nine years of correspondence and meetings between staffs of the two agencies. The pace of decision making has been attributed to several issues.

In April 2002, for example, the FAA told the NTSB that proposed changes in controller phraseology had been considered by a government-industry work group — using input from nine regional runway safety workshops and a national summit on runway safety — and that the work group's recommendations were still being reviewed.

In January 2003, U.S. controllers implemented the shortened phrase "position and hold" to reduce radio frequency congestion and confusion for non-U.S. pilots unaware of the difference between the ICAO phrase "taxi to holding position" (off the runway) and the prior U.S. phrase "taxi into position and hold" (on the runway). In February 2004, the NTSB learned that the FAA work group had "determined that the surface phraseologies in FAA Order 7110.65, *Air Traffic Control,* and ICAO *[PANS–ATM]* were as closely matched as possible."

The work group advised the FAA that substituting "line up and wait" for "position and hold" in the United States would be confusing for U.S. pilots because "hold" in all other taxiing instructions means stop the aircraft at a particular point (as in "hold short"), do not proceed any further or wait for further instruction. "These two phrases are equivalent in meaning and intent," the FAA said, agreeing to examine only "the possibility of developing a human factors study for adoption of 'line up [and wait]' and 'taxi to holding position.'"

In April 2006, the NTSB learned that the FAA expected to reach a decision about ATC procedural and phraseology changes using advice from a contracted linguistics and phraseology expert on "line up and wait" and "taxi to holding position." The effort was superseded as of October 2007, however, by the ICAO audit and the Air Traffic Organization's SMS requiring SRMD Panel analysis of all proposed changes to the National Airspace System.

"Under the SMS, we will conduct [an SRMD Panel] assessment of the procedures and phraseologies associated with the [NTSB's safety] recommendations," the FAA told the NTSB. "The [SRMD Panel] process will permit us to define hazards and mitigate any safety risks prior to the implementation of procedural/phraseology changes." For example, the assessment of "line up and wait" led the FAA to conclude that risks from the change could be managed at an acceptable level by implementing eight mitigations.[5]

The convergence of the FAA's SMS methodology, the ICAO audit corrective action plan and the commitments from the 2007 runway safety summit led to expedited review of policies for issuing taxi clearances, and the agency scheduled a six-month SRMD Panel assessment of FAA and ICAO surface phraseologies and multiple landing clearances.

In August 2008, as noted, the FAA said that it had implemented a new runway-crossing procedure. "Notice JO 7110.487 … requires that all runways along the taxi route that lead to the departure runway are crossed before a takeoff clearance is issued," the FAA said. "This procedure … excludes airport operators with airport configurations that do not allow for an aircraft to completely cross one runway and hold short of the departure runway."

'This is a dramatic change for the entire workforce of [15,000] U.S. controllers and the flight crews that will need to adjust.'

Notes

1. NTSB. Safety Recommendations A-00-66 through A-00-71. July 6, 2000.
2. FAA. Order JO 7110.65T, *Air Traffic Control,* paragraph 3-9-4, "Taxi Into Position and Hold (TIPH)," effective Feb. 11, 2010.
3. FAA. *National Runway Safety Plan 2009–2011.* June 2009.
4. ICAO Universal Safety Oversight Audit Program. "Final Report on the Safety Oversight Audit of the Civil Aviation System of the United States of America (5 to 19 November 2007)." August 2008. <www.icao.int/fsix/auditrep1.cfm?s=1>
5. "Line up and wait" mitigations require the FAA to "combine a local control position only with another local control position (local control shall not be combined with a non-local position, i.e., ground control or flight data position); ensure facility directives detail [line up and wait] operations, facility procedures, memory aids, etc.; enhance coordination between local and ground control for intersection departures; [perform] coordination either via verbal means or flight progress strips; prohibit simultaneous [operations] on the same runway unless a local assist/monitor position is staffed; mandate traffic advisories for departing and arriving aircraft on intersecting runways; emphasize on-the-spot corrective actions by supervisors/controllers-in-charge and managers during [these] operations; disseminate information to pilots via Web sites, pamphlets, etc.; and, advance awareness to pilots through national and local outreach efforts."

An Avro 146's nose landing gear failure can be traced to fatigue cracks in its main fitting, investigators say.

Gear Collapse

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BY LINDA WERFELMAN

Accident investigators blame the rough finish on a landing gear part and the incomplete performance of a corrective airworthiness directive for a fatigue failure that caused the collapse of the nose landing gear on an Avro 146-RJ100 after touchdown at London City Airport.

Three passengers were treated for minor injuries after the Feb. 13, 2009, accident, which damaged the landing gear and the lower forward fuselage, according to the final report by the U.K. Air Accidents Investigation Branch (AAIB).

The scheduled flight from Amsterdam and the instrument landing system approach in London had been uneventful, the report said.

But then, "after touching down on the main wheels, the commander, who was the pilot flying, lowered the nosewheel onto the runway," the report said. "As she did so, the aircraft continued to pitch down until the fuselage contacted the surface. She then applied the

wheel brakes fully as smoke started to emanate from behind the instrument panel. This was followed by the illumination of the 'ELEC SMOKE' warning."

The crew stopped the airplane on the runway, declared an emergency and, after the engines had stopped, ordered passengers to evacuate.

The pilots donned oxygen masks to operate the engine fire handles, completed their "evacuation drills" and evacuated the airplane through the direct vision windows, the report said.

Investigation

Investigators found scoring on the runway and a trail of hydraulic fluid, both of which indicated that the nose landing gear had broken soon after touchdown. The airplane stopped on the runway centerline about 500 m (1,641 ft) beyond the touchdown point. The landing gear had "folded rearward and penetrated the forward equipment bay," the report said, adding that the landing gear's collapse caused the lower fuselage to scrape the runway, resulting in damage to the nose landing gear doors, the fuselage skin and structure immediately behind the landing gear bay, and the forward face of the lower section of the nose landing gear.

Initial examination of the broken landing gear showed that it had fractured above its pivot, near the top of the leg.

"Visual examination of the fracture surface indicated several relatively small areas of crack progression due to a fatigue mechanism, together with a large area characteristic of a failure in overload," the report said.

Certification Tests

A review of records showed that during the manufacturer's certification testing of the nose landing gear main fitting, a test fitting completed 360,532 flight cycles without failure.

"However, a subsequent [nondestructive test] inspection identified a fatigue crack in the upper section of the internal bore that had propagated partially through the radial wall," the report said. "The surface finish (roughness) of the inner bore was confirmed as being within the limit specified at production of 3.2 microns."

In a second fatigue test, a fitting failed at 43,678 cycles without fracture, but a fatigue crack was then found in the upper internal bore; the crack had spread through the radial wall section, the report said. The surface roughness of the internal bore was measured at 6.95 microns — more than the production limit.

"Examination of the two test specimens revealed that the high value of surface roughness present in the second specimen had resulted in a significant reduction in the number of flight cycles required to initiate a fatigue crack in the material," the report said.

As a result of the tests, in June 2000, Messier-Dowty, the manufacturer of the landing gear, issued service bulletin (SB) 146-32-149, which called for an ultrasonic inspection of the main fitting bore every 2,500 flight cycles after the fitting exceeded 8,000 flight cycles. Compliance subsequently was incorporated into the U.K. Civil Aviation Authority (CAA) airworthiness directive (AD) 002-06-2000.

A second service bulletin, SB 146-32-150, called for a maximum surface roughness value of no more than 1.6 microns for the main fitting internal bore, as well as shot-peening to

The Avro 146's lower fuselage was damaged after the landing gear's collapse. Above, the accident airplane, photographed on another day, at London City Airport.

U.K. Air Accidents Investigation Branch

"restore the fatigue life of the main fitting." New main fittings were manufactured according to these specifications, and the specifications were "recommended to be [retroactively] embodied at next overhaul for in-service main fittings," the report said.

"Incorporation of this SB terminated the repetitive inspections introduced by SB 146-32-149 and CAA AD 002-06-2000," the report said, noting that the failed main fitting had been modified in accordance with SB 146-32-150.

Accident investigators found fatigue cracks on the fracture surface of the landing gear's main fitting.

U.K. Air Accidents Investigation Branch

Maintenance records showed that the nose landing gear main fitting on the accident airplane had accumulated 18,299 flight cycles, and that it had been overhauled at a Messier-Dowty facility in Sterling, Virginia, U.S., in January 2006 — 3,302 cycles before its failure. Both SBs had been in effect at the time; therefore, additional repetitive inspections of the main fitting were no longer required.

Post-Accident Examination

After the accident, the nose landing gear was removed from the airplane for analysis by the AAIB and Messier-Dowty.

The examination found no abnormalities in material or microstructure of the main fitting. Nevertheless, the report said that on the fracture surface, there were three fatigue cracks that "had become conjoined to form a single crack extending 23.2 mm [0.9 in] around the circumference of the upper section of the internal bore, with a maximum depth of 2.21 mm [0.09 in]." The fatigue crack was located in the same area where fatigue cracks were found in the two fatigue tests.

The fatigue cracks originated in "the trough of a fine circumferential machining groove" that was in the bore when the fitting was manufactured, and propagated for about 2,800 cycles before the accident, the report said. Smaller cracks were found in the same groove and in other nearby grooves.

"Examination of the inner bore confirmed that the shot-peening process had been carried out, in accordance with the requirements of SB 146-32-150, but that the surface roughness close to the origin of the fatigue cracks was 9.5 to 10.1 microns, in excess of the finish specified in the service bulletin," the report said.

Further examination showed that the landing gear actuator and torque link had failed as a result of the main fitting's failure.

Accident investigators concluded that the fracture of the main fitting caused the nose landing gear to collapse and to penetrate the lower fuselage, damaging the equipment bay and causing disconnection of the battery. When the landing gear penetrated the fuselage, hydraulic fluid was released, causing smoke and fumes to enter the airplane. Because the battery was disconnected, the remote cockpit door release mechanism could not be operated after the engines were shut down, forcing the pilots to evacuate through the cockpit direct vision windows.

Safety Actions

In August 2009, Messier-Dowty issued SB 146-32-174, describing a new ultrasonic inspection technique for the nose landing gear main fittings and prescribing a shorter re-inspection interval. The new service bulletin superseded SB 146-32-149. BAE Systems, which holds the Avro 146 type certificate, subsequently issued alert service bulletin A32-180 (Revision 1), which introduced SB 146-32-174 and canceled the requirements of SB 164-32-149, and the European Aviation Safety Agency published AD 2009-0197-E, which mandated compliance with the two new Messier-Dowty and BAE bulletins.

Messier-Dowty also issued SB 146-32-173 to require borescope inspections of nose landing gear main fittings that had been overhauled by its Sterling, Virginia, facility.

This article is based on U.K. Air Accidents Investigation Branch accident report no. EW/C2009.02/03, published in February 2010.

Mark Lacagnina

Combining Resources

European seminar highlights strategies for safety improvement.

BY MARK LACAGNINA | FROM LISBON

Urgent calls for action in establishing binding obligations to block criminal prosecution of people who provide safety information and in pooling the resources of member states to create a pan-European air accident investigation board kicked off the Flight Safety Foundation (FSF) 22nd annual European Aviation Safety Seminar (EASS) March 15–17 in Lisbon, Portugal.

More than 200 aviation professionals attended the seminar, which was co-presented by the European Regions Airline Association (ERA) and Eurocontrol.

A regulation on aviation accident investigation and occurrence reporting proposed recently by the European Commission (EC) was the focus of a discussion led by Mike Ambrose, ERA director general, and Kenneth P. Quinn, FSF general counsel and secretary, and a partner in the Washington law firm Pillsbury.

Ambrose said that although well-intentioned, the EC's proposal "is very unlikely to create any significant improvement in air safety." Its major drawback, he said, is that it misses a major opportunity to strengthen occurrence reporting by guaranteeing confidentiality for people who report safety-critical events and for the people identified in the reports.

Quinn said that there is an "increasing tendency to turn accident sites into crime scenes" and discussed several investigations that were impeded by prosecutors and police, resulting in restrictions of access to physical evidence and the refusal of individuals involved in the accidents to cooperate with investigators.

'Enough Is Enough'

"The flow of important safety information is being hampered and delayed," Quinn said. "Enough is enough. This prosecutorial abuse is directly putting safety on trial and the public at risk, and it's time to end that."

Regarding the current manslaughter trial of Continental Airlines and five individuals in connection with the July 25, 2000, crash of Air France 4590, a Concorde that received foreign-object damage on takeoff from Paris, he said, "We at the Foundation believe that case is an utter waste of resources and a great example of prosecutorial abuse, and should be shut down now."

Ambrose and Quinn emphasized the importance of time. "Accident investigation needs to be rapid so that lessons are learned quickly and are passed on to the operators," Ambrose said. "It must not be jeopardized by judicial systems or other external agencies that seize some of the wreckage or some of the information."

ERA has called on the European Council and Parliament, which are reviewing the EC proposal, to ensure that aviation investigatory agencies have priority over other agencies and to prohibit access by other agencies, the media and the public to information gathered during an investigation without guarantees of confidentiality.

Economic concerns must not outweigh safety, said Lynn Brubaker.

Emily McGee

'Obligations With Teeth'

ERA and the Foundation have joined several organizations in calling upon the International Civil Aviation Organization (ICAO) to strengthen its protection of safety information sources.

Quinn said that ICAO Annex 13, which sets the standards and recommended practices for aircraft accident and incident investigation, "simply does not go far enough in protecting sources of data and information that are absolutely critical to safety improvement.

"Unless we foster a just culture environment, when we ask people to come forward with safety-sensitive information, we may inadvertently be setting them up for a loss of liberty. And that's not fair. We need to make sure that there are international obligations — with teeth — to protect these individuals."

Quinn noted that protection of safety-information sources is among the topics on the agenda for the ICAO High-Level Safety Conference in Montreal from March 29 to April 1. "The Foundation embraces recommendations that ICAO form a multidisciplinary task force of legal experts from the aviation industry, law enforcement, judicial authorities and the public to achieve a balanced approach that is supportive of blameless reporting and sharing of critical aviation safety information and the proper administration of justice," he said.

'Mandatory Club'

Ambrose and Quinn characterized as flawed a provision of the EC proposal to establish a "European Network of Civil Aviation Safety Investigation Authorities" comprising state investigatory agencies, the European Aviation Safety Agency (EASA) and EU judicial departments, prosecuting offices and police that would operate under voluntary agreements to cooperate in accident investigations.

Emily McGee

Kenneth Quinn called for an end to the increasing tendency to turn accident sites into crime scenes.

Ambrose said that the proposal for a "mandatory cooperative club … is a recipe for costly inefficient bureaucracy with no safety benefits."

"Voluntary co-operation is a recipe for no cooperation," Quinn said. "We need to have clear legal obligations." He noted that the Foundation supports a recommendation by ERA to scrap the proposed network and go forward with an option initially considered by the EC but rejected as "premature": the creation of a European civil aviation safety board.

"One of the reasons, we are told, that the Commission has not gone down this road is that the results from EASA have been less than satisfactory, and neither the Council nor the Parliament is consequently interested in establishing another EU-wide institution," Ambrose said.

Nevertheless, a multinational investigatory agency would have significant advantages, he said. "It would permit the pooling of resources to provide improvements in training, facilities, equipment and investigation techniques. We would achieve collectively far higher standards of accident investigation."

'Spiral Dive'

Further insight on how criminal prosecution impedes safety reporting was provided by Hans Houtman, consultant and former incident investigation coordinator for ATC The Netherlands. "The open culture of reporting incidents has become very fragile," he said.

Characterizing increased criminal prosecution as a "spiral dive that will be hard to stop," Houtman said that society must move away from the "old view that punishment is the best way to eliminate errors and mistakes."

Avoidance, detection and correction of human error are among the key issues addressed by the *Operators Guide to Human Factors in Aviation* (OGHFA), a topic presented by Jean-Jacques Speyer, a university professor and retired senior director of flight operations and training for Airbus.

Speyer said that OGHFA, a product of the FSF European Advisory Committee, comprises various materials addressing more than 100 human factors topics. Available on the SKYbrary Web site, OGHFA is meant to supplement and support threat and error management, he said.

'We Need New Ideas'

Concerns about the impact of the continuing economic downturn on safety efforts were voiced by Lynn Brubaker, FSF board chairman, and by David McMillan, director general of Eurocontrol.

"The industry must continue to research, investigate, innovate and educate on safety," Brubaker said.

"We must ensure that cutbacks do not have an effect on safety programs," McMillan said. "We cannot afford to slow down our efforts. Aviation safety in Europe, although improving, still has a long way to go."

A rundown of accident statistics for worldwide passenger and cargo airline operations was provided by David Learmount, operations and safety editor for *Flight International*. He said that although the 28 fatal accidents and 749 fatalities last year were below the decade averages of 31 and 806, respectively, "traffic fell significantly in 2009, so the figures, when the rates have been finalized, will not look as good."

Learmount discussed FSF data showing that the serious accident rate among Western-built jets in the 1990s dropped by nearly one-half this decade. He attributed this "giant leap in safety" to the "harvesting of the fruits of the seeds sown in the 1980s and 1990s," including the advent of data-driven safety strategies, the Foundation's efforts to reduce approach and landing accidents and controlled flight into terrain, and the global mandate of terrain awareness and warning systems.

Since 2003, however, "there's been no improvement at all in terms of accident numbers," Learmount said. "Preventable accidents are still happening, so there is still plenty of room for improvement. We need to come up with new ideas."

Michel Tremaud, retired head of safety management for Airbus, said that safety can be improved if the industry does a better job of identifying accident/incident precursors and utilizing the lessons learned from them. The best tool for this is flight data monitoring that includes interviews with the pilots, flight attendants, air traffic controllers, maintenance technicians and others involved, he said.

Tremaud also cautioned that change should be viewed as a potential precursor. "Changes bring improvement, but they also carry their own risks," he said. "We need to evaluate changes to identify the risks they could bring."

Persistent Excursions

Jim Burin, FSF director of technical programs, discussed the Foundation's effort to reduce runway excursion accidents, which include overruns and veer-offs. He said that the frequency of runway excursion accidents has remained steady at about 30 per year.

Data gathered by the Foundation show that most landing accidents result from unstabilized approaches and from not taking advantage of the opportunity to go around, while most takeoff accidents result from takeoffs rejected above V_1.

The latter was the topic of a presentation by Gerard van Es, senior consultant on flight safety and operations for the NLR Air Transport Safety Institute. He said that although V_1 is based on an engine failure, about 80 percent of the 135 high-speed rejected takeoffs (RTOs) in large commercial airplanes that led to accidents or serious incidents from 1980 through 2008 resulted from other factors such as aircraft configuration, wheel/tire failures, directional control problems, noises/vibrations and bird strikes.

Van Es said that in nearly one of five occurrences, the RTO decision was made before V_1 but action to reject the takeoff was not taken until V_1 was exceeded. A possible factor is a standard operating procedure at most airlines that requires the captain to call and perform an RTO. "This might involve a transfer of control, causing difficulties and delays, if the first officer is the pilot flying," he said.

'Train Like You Fly …'

Paul Miller, a member of the Independent Pilots Association safety committee, and David Williams, a former line captain and check airman, explored the relationship between training and safety.

Pointing to several recent major accidents, Williams said, "It is not poor pilots who are crashing airplanes but pilots who have been improperly trained. … You have to confirm that you train like you fly and that you fly like you train."

Miller said that the safety department and the training department often are viewed by airlines as costs rather than investments. "Every airline should be training at the same level," he said.

Other presentations at EASS 2010 included a discussion by Alexander Krastev, a Eurocontrol safety expert, of a wide-ranging program recently launched by the organization to counter the rising trend in airspace infringements.

Thomas Lange, senior safety pilot for Boeing, presented the lessons learned about fuel system icing during the investigation of the Boeing 777 approach accident at London Heathrow Airport.

The "Aerospace Performance Factor," a tool for integrating and monitoring safety data gathered throughout an airline's operations, was described by Kenneth Neubauer, technical director for aerospace safety at Futron.

Ed Pooley, principal consultant for The Air Safety Consultancy, discussed the role of the safety pilot in augmenting and monitoring the flight crew during approach and landing. He noted that very little guidance exists for intervention by the safety pilot.

The importance of managerial communication to safety and strategies for improving it were presented by Randy Ramdass, senior director of technical operations for Continental Airlines.

Emma Romig, principal investigator for flight deck research and development at Boeing, discussed the various regulatory approaches to combating fatigue. She also described a fatigue risk management system developed for the Chinese civil aviation authority.

Joseph Texeira, director of safety programs for the U.S. Federal Aviation Administration, described a new system developed by the agency to gather and analyze reports by air traffic controllers. He said that most reports to date have identified "procedures that were not working" and required correction.

Ben Winfree and Ken Nagel, partners at Alertness and Performance Management, presented the results of a recent survey of 1,359 regional airline pilots. They said the results show the need for education on fatigue risk management and for possible medical help for pilots suffering from chronic fatigue.

Adrian Young, manager of quality assurance for Denim Air, described the hazards of operating in remote areas and how his company meets the challenges of maintaining a high level of safety.

The final proceedings of EASS 2010, on CD, will be mailed to all FSF members. Information on purchasing a copy of the proceedings is available in the "Aviation Safety Seminars" section of the FSF Web site, <www.flightsafety.org>.

U.S. transportation officials expect to finalize new rules later this year for the air transportation of lithium batteries and cells — including those that are packed with or contained in equipment.

Dozens of organizations submitted comments on proposed rules changes before the public comment period ended in mid-March. The Pipeline and Hazardous Materials Safety Administration (PHMSA) — the U.S. Department of Transportation agency that developed the notice of proposed rule making (NPRM) in cooperation with the Federal Aviation Administration (FAA) — said the changes are needed to reduce the chemical and electrical risks associated with lithium batteries.

"This rule making is important for the protection of the traveling public and many of those who work in the aviation industry," U.S. Transportation Secretary Ray LaHood said. "This rule will help

BY LINDA WERFELMAN

Battery Rules

U.S. officials are considering proposed changes in the requirements for transporting lithium batteries in cargo and passenger aircraft.

'This rule will help us achieve a safer aviation environment without imposing a ban on the transport of lithium batteries by air.'

us achieve a safer aviation environment without imposing a ban on the transport of lithium batteries by air."

The proposed rules, published in the *Federal Register* on Jan. 11, 2010, apply to lithium batteries and cells transported in cargo airplanes or in the cargo holds of passenger airplanes — not to individual batteries carried on board by passengers in their personal electronic equipment.

"If not safely packaged and handled, lithium batteries can present a significant risk in transportation," PHMSA said in the proposed rule. "Batteries which are misused, mishandled, improperly packaged, improperly stored, overcharged, or defective can overheat and ignite, and, once ignited, fires can be especially difficult to extinguish. Overheating has the potential to create a thermal runaway, a chain reaction leading to self-heating and release of the battery's stored energy."

PHMSA and the FAA have identified 44 air transport-related incidents since 1991 that involved lithium batteries that overheated or short-circuited. The incidents "illustrate the short circuit and fire risks … and the potential for a serious incident," the proposed rule said. Of the 44 incidents, 23 occurred on cargo aircraft, four in passenger aircraft cargo holds, one in checked baggage and 16 in carry-on items.

In addition to these incidents, PHMSA noted that a United Parcel Service McDonnell Douglas DC-8-71F and most of its cargo were destroyed by a fire that was believed to have been caused by lithium batteries. The three crewmembers in the airplane evacuated after landing at Philadelphia International Airport; all three received minor injuries from smoke inhalation (*ASW*, 4/08, p. 28).[1]

As a result of its investigation of that accident, the U.S. National Transportation Safety Board (NTSB) issued a series of safety recommendations, including requiring operators of cargo airplanes to transport the batteries in fire-resistant containers and/or to limit the quantity of batteries at any single location on an airplane.

Proposed Changes

The changes proposed by PHMSA include the following:

- "Eliminate regulatory exceptions for small lithium cells and batteries when included in an air shipment and require their transportation as Class 9 materials,[2] meaning they could pose a hazard when transported;
- "Subject packages of small lithium batteries to well-recognized marking and labeling requirements for hazardous materials;
- "Require transport documentation to accompany a shipment of small lithium batteries, including notifying the pilot-in-command of the presence and location of lithium batteries being shipped on the aircraft;
- "Require manufacturers to retain results of satisfactory completion of United Nations design-type tests for each lithium cell and battery type;
- "Limit stowage of lithium cell and battery shipments aboard aircraft to cargo locations accessible to the crew or locations equipped with an FAA-approved fire suppression system, unless transported in a container approved by the FAA administrator; and,
- "Apply appropriate safety measures for the transport of lithium cells or batteries identified as being defective for safety reasons, or those that have been damaged or are otherwise being returned to the manufacturer, and limit the transportation of defective or damaged cells or batteries to highway and rail."

Public Comments

In comments submitted in response to the proposed changes, the Air Line Pilots Association, International (ALPA) said it "has long voiced concern that current provisions in the hazardous materials regulations governing the transport of lithium batteries by air are inadequate to protect crewmembers, passengers, cargo and

the traveling public" and that the organization supports most sections of the NPRM.

ALPA specifically endorsed several provisions, including the elimination of exceptions for small lithium batteries, saying that the batteries "present an unusual, significant risk in transportation, since nothing more than a damaged package is necessary to start a fire, possibly several hours after the damage occurred."

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The organization also endorsed provisions to strengthen requirements for testing new lithium battery designs and to revise shipping names for lithium batteries to differentiate between lithium ion batteries and lithium metal batteries, which have different chemistries and different fire characteristics.

The International Federation of Air Line Pilots' Associations (IFALPA) said that it also supports adoption of the NPRM, although "we would prefer a globally harmonized approach" to regulating the transport of lithium batteries. IFALPA is especially supportive of sections of the NPRM that would "align [U.S. regulations] with the provisions in the International Civil Aviation Organization (ICAO) 'Technical Instructions for the Safe Transport of Dangerous Goods,'" and it cited provisions to "adopt new, proper shipping names for lithium ion and lithium metal batteries and to adopt a watt-hour rating in lieu of equivalent lithium content."

'Nothing more than a damaged package is necessary to start a fire, possibly several hours after the damage occurred.'

The International Air Cargo Association said that portions of the NPRM "veer sharply away" from the concept of international harmonization with "numerous regulations that would deviate significantly from international standards." As an example, the association cited provisions that deviate from ICAO's "Technical Instructions" by "eliminating exceptions for most small, consumer-type batteries … and by restricting where such shipments may be stowed aboard aircraft."

The association said the "real problem … is lithium battery shipments that are not compliant with existing regulations. … This calls for better enforcement, rather than sweeping new regulations."

The Air Transport Association of America (ATA), noting that its member carriers transport 90 percent of U.S. airline passenger and cargo traffic, said the NPRM is "far more restrictive" than ICAO's requirements.

"The measures proposed … are not likely to address the root causes of past or potential future incidents in air transportation but would certainly result in substantial processing and operational delays that would disrupt the expeditious movement of goods along the supply chain and cause significant economic harm to a broad spectrum of commerce," the ATA said. "Such disruptive impacts should be carefully considered along with a thorough and candid evaluation of the effectiveness of proposed changes."

The Rechargeable Battery Association recommended that PHMSA abandon the NPRM in favor of the ICAO requirements.

The association "remains strongly committed to safety," said Executive Director George Kerchner, "but this rule would not address the principal cause for concern — non-compliance by shippers with existing transport regulations — while imposing unacceptable costs on all Americans."

In its public comment, the association added, "Billions of lithium ion cells and batteries have been shipped over the past decade, many repeatedly, without a single fire on an aircraft attributable to lithium ion cells, batteries or the products into which they are incorporated where existing U.S. regulations … were complied with."

Notes

1. NTSB. Accident Report NTSB/AAR-07/07: *Inflight Cargo Fire: United Parcel Service Company Flight 1307, McDonnell Douglas DC-8-71F, N748UP, Philadelphia, Pennsylvania, February 7, 2006.* The NTSB was unable to determine the cause of the fire because "potentially helpful evidence" was destroyed in the blaze.
2. Class 9 materials are designated by the U.S. Department of Transportation as "miscellaneous dangerous goods."

Further Reading From FSF Publications

Rosenkrans, Wayne. "Thermal Runaway." *AeroSafety World* Volume 3 (March 2008): 42–48.

BY HEMANT BHANA

By the Book

Good written guidance and procedures reduce pilots' automation complacency.

As flight deck automation technology has advanced, most commercial transport pilots have transitioned from active participants in many processes to supervisors of the automation. Unfortunately, this shift can lead to complacency. Aviation-related automation complacency occurs when a pilot over-relies on and excessively trusts the automation, and subsequently fails to exercise his or her vigilance and/or supervisory duties.[1]

Stated differently, "Pilots may become complacent because they are overconfident in and uncritical of the automation, and fail to exercise appropriate vigilance, sometimes to the extent of abdicating responsibility to it [which can] lead to unsafe conditions."[2] The U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) publication *Callback* defines complacency throughout multiple issues as "the state of self-satisfaction that is often coupled with unawareness of impending trouble."[3]

These definitions imply that complacency occurs when the automation supervisor is unaware of the current or impending actions of the machine. Sometimes, this can have tragic results, as evidenced in December 1995, when an American Airlines crew flying a Boeing 757 did not notice the aircraft's automation activity, resulting in a fatal crash near Cali, Colombia.[4]

Against this backdrop, the author developed a scale to measure automation complacency–related behaviors as part of a broader study on complacency and boredom.[5] That broader study was based on ASRS reports from the 10-year period between January 1999 and January 2009. The search criteria were restricted to anomaly reports from U.S. Federal Aviation Regulations Part 121 operations, in which the causal factor category was flight crew human performance.

The search looked for any narrative or synopsis containing variations of the terms "FMC/FMS" (flight management computer/flight management system), "automation" and "complacency." The search criteria revealed over 560 records, which the author cataloged and categorized. Those, in turn, were used to develop questions probing the identified behaviors for the survey whose results are shown here. The questions emphasized routine practices and the deliberateness of a particular action (e.g., "How often do you deliberately … "). Survey instructions accentuated the need for honest answers and guaranteed anonymity.

Participants in the survey completed their responses online without time constraints. Each pilot was experienced in advanced automated aircraft because of the nature of the airline's fleet. Of the 273 respondents, 87.8 percent were male. The majority (54.4 percent) were between the ages of 41 and 50, with the next highest group between the ages of 51 and 60 (28.2 percent). Examining their types of flight operations found that 64.3 percent flew narrowbody aircraft in domestic U.S. operations plus Canada and Mexico, while 35.7 percent flew widebody aircraft in the international realm. Finally, 54.5 percent had flown their airplane type for more than four years. The next highest group (22.3 percent) had flown their airplane type between two and four years. The "aircraft longevity" pilot groups of one to two years experience and less than one year experience comprised 9.9 percent and 13.4 percent of the sample, respectively. The sample group represented 4.5 percent of the total pilot population of the airline.[6]

The term *automation complacency* is interchangeable with *automation overconfidence*, and broadly defined as an operator no longer applying the appropriate automation supervision and monitoring. Examining the results from the ASRS data allowed a factorial approach to the issue and revealed four subcategories. Following each subcategory below are the related survey questions and results. The results indicate the frequency of the queried behavior as a function of time. For example, a pilot could report being engaged in a particular behavior between 31 and 45 percent of the time.

Failure to Notice

Pilots fail to notice the automation mode or autopilot state after an FMS reprogram or other distracting event (distraction complacency; Table 1). Common behaviors include:

Air traffic control (ATC) issues a late runway change, causing pilots to reprogram the FMS. The pilots do not notice that the descent mode has changed or do not notice that the altitude crossing restrictions have dropped out. In both cases, an altitude-crossing deviation occurs;

The pilots reprogram the FMS with new information during a mode change (for example, the aircraft leveling after a descent or climb). The pilots do not notice the ensuing mode reversion, resulting in an altitude deviation;

Pilots reprogram the FMS with a new lateral route and fail to notice that the disruption in navigation information has caused the automation to revert to HDG (heading) mode. This causes the automation to follow heading information instead of programmed track guidance, possibly resulting in a track deviation; and,

The pilots experience an event that causes their workload to spike, such as a system failure or a procedure interruption caused by nonessential issues.

Distraction Complacency, U.S. Airline Pilot Sample

1. On the majority of your flights, if ATC issues a runway change or other event that causes an FMS reprogram, how often do you deliberately check the automation mode (managed/VNAV PATH/open descent/level change, etc.)?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.03 SD = 1.46 N = 276	5.8% (16)	5.1% (14)	3.3% (9)	6.5% (18)	25.4% (70)	54.0% (149)

2. On the majority of your flights, if ATC issues a runway change or other event that causes an FMS reprogram, how often do you deliberately check to ensure any altitude crossing restrictions are still programmed?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.11 SD = 1.31 N = 276	3.3% (9)	4.7% (13)	3.6% (10)	9.4% (26)	24.6% (68)	54.3% (150)

3. If you are interrupted by an event (such as a cabin issue, restroom break, etc.) how often do you deliberately check the aircraft's automation mode after the event?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 3.89 SD = 1.69 N = 276	12.7% (35)	13.0% (36)	12.7% (35)	15.6% (43)	25.7% (71)	20.3% (56)

4. When ATC issues a direct-to or a new flight plan routing or another lateral event that requires an FMS reprogram, how often do you deliberately check to ensure the NAV mode is engaged?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.37 SD = 1.07 N = 276	1.4% (4)	2.5% (7)	3.6% (10)	4.3% (12)	26.4% (73)	61.6% (170)

ATC = air traffic control FMS = flight management system; M = mean; N = number of respondents; SD = standard deviation

Note: Pilots sampled were from a U.S. airline operating under U.S. Federal Aviation Regulations Part 121.

Source: Hemant Bhana

Table 1

The pilots then fail to recognize any resulting improper automation modes.

No Cross-Checking

Pilots do not cross-check the automation for the correct restrictions, route or information (cross-check failure complacency; Table 2). Common behaviors include:

A pilot failing to ensure the FMS has the correct departure, en route or arrival route programmed, resulting in a track deviation;

Pilots receive a new routing from ATC, and subsequently fail to ensure the FMS has activated the correct waypoint;

Pilots fail to program the correct altitude-and-speed crossing restrictions in the FMS;

Pilots enter a direct-to routing, and fail to ensure that the aircraft is proceeding to the correct waypoint;

Pilots fail to confirm that the selected arrival or departure procedure waypoints and/or restrictions match the charted procedure;

Pilots set the automation guidance (FMS, instrument landing system [ILS], etc.) to the incorrect parallel runway, resulting in inbound tracking of the incorrect runway; and,

Failure to Monitor

Pilots fail to notice incorrect performance information, resulting in improper altitudes, speeds and weight-and-balance information.

Pilots fail to monitor the automation to ensure it is behaving as expected or required (monitoring complacency; Table 3, p. 50). Common behaviors include:

Pilots fail to monitor vertical automation with raw data information to ensure the aircraft will adhere to the altitude crossing restriction;

Pilots fail to ensure the aircraft automation is performing as expected by failing to notice the aircraft has not acquired the top of descent point; failing to notice the aircraft is not in the appropriate automation mode; and failing to ensure proper navigation or speed capture and hold;

Pilots fail to monitor lateral automation with raw data information to ensure the aircraft is on the correct navigation track; and,

Pilots fail to notice the automation has either overshot or undershot the assigned altitude.

Inappropriate Automation

Pilots use the automation inappropriately, or rely only on automation flight guidance, instead of exercising manual pilot skills or abilities (over-reliance complacency; Table 4, p. 51). Common behaviors include:

Pilots attempt to use the automation to salvage a poor approach or a violation of the FARs (such as exceeding the 250 kt indicated airspeed limit below 10,000 ft);

Pilots use the autopilot to capture the localizer and glideslope on the ILS, and do not manually take over when the aircraft does not capture the landing guidance or behaves unexpectedly;

Pilots fixate on programming the FMS during high-workload situations to the exclusion of monitoring the aircraft's state;

Pilots exhibit poor flying skills when the automation disengages without pilot action; and,

On an ILS, the pilots continue to follow erroneous flight director guidance despite localizer and/or glideslope anomalies.

The results indicated good automation practices by the sample group and, by extension, the entire pilot population. The automation practices, when viewed against the airline's operations manual, indicated a strong adherence to standard operating procedures and good automation techniques.

This finding increases the importance of having written and enforceable guidance for pilots to follow. For example, the results from question 3 show a wide distribution of answers relating to the frequency of automation mode awareness after a distraction (mean [M] = 3.89, standard deviation [SD] =1.69). A pilot examining the airline's operating manual will find very limited guidance about deliberately checking the aircraft's automation mode after an interruption. The closest analog in the flight manual

Cross-Check Complacency, U.S. Airline Pilot Sample

5. On your flights, how often do you deliberately check that the FMS is programmed with the correct SID, en route path, and STAR against the flight plan and/or ATC clearance?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.85 SD = 0.49 N = 276	0.0% (0)	0.4% (1)	0.4% (1)	2.2% (6)	8.0% (22)	89.1% (246)

6. When receiving a direct-to instruction or programming the FMS and more than one waypoint with the same name is displayed, how often do you check the position (frequency, distance, LAT/LONG) of the selected waypoint to ensure it is the desired one?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.09 SD = 1.48 N = 276	5.4% (15)	5.1% (14)	5.4% (15)	4.3% (12)	18.8% (52)	60.9% (168)

7. When issued a departure or an arrival route, how often do you check to ensure the correct routing and/or altitude-crossing restrictions are programmed in the FMS against the Jeppesen or other kind of chart?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.60 SD = 0.91 N = 276	0.7% (2)	2.2% (6)	1.4% (4)	4.3% (12)	14.5% (40)	76.8% (212)

8. If ATC issues a "direct-to" instruction, how often do you switch to the plan view to ensure the aircraft is actually proceeding to the correct waypoint?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 3.49 SD = 2.21 N = 276	38.0% (105)	6.9% (19)	1.8% (5)	6.9% (19)	14.1% (39)	32.2% (89)

9. When operating at an airport with parallel runways (for example, Runways 35L and 35R), how often do you deliberately check (during the approach briefing or any other time) to ensure the correct runway and/or localizer frequency is programmed in the FMS and/or NAV radios?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.79 SD = 0.64 N = 276	0.4% (1)	0.7% (2)	0.7% (2)	1.8% (5)	10.1% (28)	86.2% (238)

10. When inputting performance data (such as V-speeds, center of gravity, and weight information), how often do you deliberately check the data for accuracy and/or reasonableness?

	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
M = 5.57 SD = 0.94 N = 276	1.4% (4)	1.1% (3)	1.8% (5)	5.4% (15)	15.2% (42)	75.0% (207)

ATC = air traffic control; FMS = flight management system; LAT/LONG = latitude and longitude; M = mean; N = number of respondents; NAV = navigation; SD = standard deviation; SID = standard instrument departure procedure; STAR = standard terminal arrival procedure

Note: Pilots sampled were from a U.S. airline operating under U.S. Federal Aviation Regulations Part 121.

Source: Hemant Bhana

Table 2

Monitoring Complacency, U.S. Airline Pilot Sample

11. When issued an altitude crossing restriction, how often do you monitor the aircraft's computed vertical path using mental math and/or raw-data information?

M = 5.42 SD = 1.03 N = 276	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	1.8% (5)	1.4% (4)	2.5% (7)	6.5% (18)	22.8% (63)	64.9% (179)

12. On the majority of your flights, when ATC issues an altitude crossing restriction, how often do you deliberately monitor your proximity to the top of descent point, and, if applicable, ensure the automation has captured the descent path?

M = 5.68 SD = 0.73 N = 276	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	0.4% (1)	0.4% (1)	2.2% (6)	3.3% (9)	15.9% (44)	77.9% (215)

13. For the majority of your flights, when conducting flight maneuvers (starting a descent, starting a climb, leveling off from a climb/descent, engaging NAV, etc.), how often do you deliberately monitor the aircraft's mode to ensure it is doing what is desired?

M = 5.69 SD = 0.61 N = 276	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	0.0% (0)	0.0% (0)	1.4% (4)	3.6% (10)	19.2% (53)	75.7% (209)

14. When issued a SID that is "navable" by the FMS (not an RNAV SID), how often do you deliberately back up your lateral guidance with raw-data information and/or mental computations?

M = 3.65 SD = 1.87 N = 276	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	20.7% (57)	14.5% (40)	9.1% (25)	11.6% (32)	23.2% (64)	21.0% (58)

15. For the majority of your flights, how often do you track the actual waypoint time and fuel burn against the predicted values during cruise?

M = 4.45 SD = 1.56 N = 273	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	8.1% (22)	5.5% (15)	12.1% (33)	14.3% (39)	27.5% (75)	32.6% (89)

16. On your flights, how often do you deliberately watch the altimeter to ensure the automation has captured the correct (assigned) altitude after a climb and/or descent?

M = 5.46 SD = 0.94 N = 273	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	0.7% (2)	1.5% (4)	2.6% (7)	8.1% (22)	20.5% (56)	66.7% (182)

ATC = air traffic control; flight management system; M = mean; N = number of respondents; RNAV SID = area navigation standard instrument departure; SD = standard deviation

Note: Pilots sampled were from a U.S. airline operating under U.S. Federal Aviation Regulations Part 121.

Source: Hemant Bhana

Table 3

describes procedures for handling a checklist after a distraction.

However, question 5 results indicated a very narrow answer distribution regarding cross-checking the FMS for route accuracy (M = 5.85, SD = 0.49). The operational guidance in this case deliberately tasks each pilot with independently verifying the accuracy of the FMS entries.[7] Further written guidance at several other locations in the flight manual emphatically requires pilots to compare their routing with the pre-departure clearance (PDC) and flight plan. Training syllabi, evaluations and line checks further emphasize these practices.

As another example, the results on question 14 also indicated a wide distribution of answers, indicating variance among the responses about how pilots cross-check lateral navigation (LNAV) data not based on area navigation (RNAV) (M = 3.65, SD = 1.87).

The ASRS narrative data contained multiple instances when pilots did not cross-check their LNAV data, resulting in a lateral track deviation. Many of these deviations occurred when the pilots did not have an adequate situational awareness of their current position during LNAV operations — a problem mitigated by referencing raw data information such as a radio magnetic indicator needle for additional reference. The airline flight manual guidance issued to pilots on this topic is conditional, and only references certain conditions when flight crews are required to back up LNAV information with radio-based raw data information, despite anecdotal evidence of the benefits of radio-based raw data for additional situational awareness.

Moreover, the language used to advise pilots on this matter is complex, requiring high cognitive processing to understand. This example highlights the benefits of clear and concise language in the flight manual. When technical writers create complex guidance stipulating multiple conditions, they inadvertently cause inconsistency in pilot behavior.

In contrast, procedure description that is declarative, clear, concise and well emphasized causes little variance in the associated pilot behavior, as shown by the data for question 13. The airline's flight manual instructs pilots in boldface that "during all phases of flight, both pilots must be aware of the [automation modes] and verify that they reflect the intended autoflight modes." In other sections of the manual, the guidance emphasizes this concept by further instructing pilots to say aloud the automation mode during specific phases of flight.

The responses to question 13 indicated a strict adherence to this

Over-Reliance Complacency, U.S. Airline Pilot Sample

17. Think about the occasions where you have been "behind the airplane" with the autopilot on. For those times, how often did you turn the automation off when correcting (no autopilot or auto-thrust) versus keeping the automation on?

M = 3.79, SD = 1.61, N = 273	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	12.8% (35)	12.1% (33)	12.8% (35)	22.3% (61)	24.9% (68)	15.0% (41)

18. During high workload situations when FMS reprogramming is required, how often have you found yourself fixating on the FMS?

M = 2.92, SD = 1.31, N = 273	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	16.1% (44)	26.4% (72)	21.6% (59)	23.1% (63)	11.4% (31)	1.5% (4)

19. For the majority of your flights, how often have you found yourself focusing on the flight director to the exclusion of other guidance cues (LOG/GS indications, map view, RMI, etc.)?

M = 2.14, SD = 1.28, N = 273	0–15%	16–30%	31–45%	46–60%	61–85%	86–100%
	41.0% (112)	28.6% (78)	14.3% (39)	8.8% (24)	6.2% (17)	1.1% (3)

20. How confident are you in being able to turn off all the automation (autopilot and auto-thrust) and hand fly the aircraft in any weather condition, day or night, should the automation start behaving unexpectedly?

M = 1.39, SD = 0.67, N = 273	Very confident	Confident	Somewhat confident	A little confident	Not confident at all
	69.2% (189)	23.8% (65)	5.9% (16)	0.7% (2)	0.4% (1)

ATC = air traffic control; FMS = flight management system; LOC/GS = localizer or glideslope; M = mean; N = number of respondents; RMI = radio magnetic indicator; SD = standard deviation

Note: Pilots sampled were from a U.S. airline operating under U.S. Federal Aviation Regulations Part 121.

Source: Hemant Bhana

Table 4

guidance, with low variation in the answers, indicating that pilots are closely adhering (M = 5.69, SD = 0.61). Proper emphasis in the form of formatting, language and repetition can positively affect automation behavior.

Finally, this airline encourages hand-flying proficiency. Its manual says, "Stick and rudder proficiency is critical to the full set of skills necessary to successfully operate autopilot/autoflight airplanes. Hand flying is encouraged when traffic and workload permit." This operating philosophy could explain the confidence pilots have in their flying skills.

According to the survey responses to question 20, 69.2 percent of pilots in the sample are "very confident" of their piloting skills, probably because the associated standard operating procedures (SOPs) both permit and encourage hand flying practice. Another question in this survey (not published in this article) indicated that 85.3 percent of the sample group hand flew as much as possible, thus possibly avoiding an over-reliance on the automation. Moreover, hand flying proficiency reduces the pilots' dependence on the automation by allowing manual practice under pilot-controlled terms rather than only when the automation is misbehaving or disengages without pilot action. The ability to slowly develop hand flying proficiency under controlled, non-ideal conditions will reduce the chance a pilot will exhibit an automation complacency–related behavior.

Despite advanced automation in modern airliners, the results of this survey indicate that sound standard operating procedures that focus on the fundamentals of aviation can mitigate many automation complacency–related behaviors. Creating an awareness of the potential pitfalls of modern automation through written SOPs and automation-focused training might prevent a future tragedy.

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6. The sample size of 273 (out of roughly 6,000) of the airline's pilots yields a confidence level of 95 percent with an error rate of 5.8 percent. That is, one can be 95 percent confident that the sample's answers reflect the total pilots in the airline with up to a 5.8 percent error rate.

7. I have not cited the airline's flight manual. To do so would identify the airline and violate my research agreement with the company.

A Code Shared Accident

A television documentary finds the roots of the Colgan Air Flight 3407 accident in the changed structure of the U.S. airline industry.

AUDIO-VIDEO

Regionals Under Scrutiny

Flying Cheap

Frontline. WGBH Boston. Producers: Rick Young and American University School of Communication, Investigative Reporting Workshop. Aired by Public Broadcasting System (PBS), Feb. 9, 2010. 56 minutes. Available on the Internet as a video, audiocast and DVD at <www.pbs.org/wgbh/pages/frontline/flyingcheap>.

For those who did not view the *Frontline* program, "Flying Cheap," when it aired on U.S. television, PBS has made it available on the Internet. The video and its full-text transcript may be viewed and read online at no charge. The program is also available for purchase as a DVD or as a free downloadable audio podcast.

The introduction to "Flying Cheap" says, "One year after the deadly airline crash of Continental [Connection Flight, operated by Colgan Air] 3407 in Buffalo, New York, U.S. *Frontline* investigates the accident and discovers a dramatically changed airline industry, where regional carriers now account for half of the nation's daily departures. The rise of the regionals and arrival of low-cost carriers have been a huge boon to consumers, and the industry insists that the skies remain safe. But many insiders are worried that now, 30 years after airline deregulation, the aviation system is being stretched beyond its capacity to deliver service that is both cheap and safe" (see "Startled and Confused," p. 20, and "Mutual Aid," p. 26).

According to the program, the "code sharing" sales and marketing relationship between the regionals and the major carriers is a cause for concern.

The program includes interviews and discussions with a number of individuals who play significant roles in the commercial aviation industry, including William R. Voss, president and CEO, Flight Safety Foundation (FSF); John Prater, an airline captain and president, Air Line Pilots Association, International (ALPA); Roger Cohen, president, Regional Airline Association; former Colgan pilots; and former and current officials of the U.S. Federal Aviation Administration (FAA) and the U.S. National Transportation Safety Board (NTSB). There are also interviews with family members of accident victims.

The video is formatted into six discussion topics.

"The Harrowing Crash of Continental 3407" gives an overview of the flight and begins to address issues identified in the NTSB hearings and investigation. Clay Foushee, investigator for the U.S. Congress, says, "[The accident has] become a symbol of everything that's wrong with the industry." Foushee and the narrator refer to it as a "watershed accident."

Corey Heiser, a Colgan Air pilot from 2005 to 2009, says, "We are only paid when the door's closed and the engines are running. … We may be on duty for 80 hours a week and get paid for 20 of it, if we're lucky." The narrator and reporter, Miles O'Brien, says, "Low pay and high living costs have created an underground housing market in the airline industry." Chris Wiken, a former Colgan Air pilot, says that "you can picture a one- and two-bedroom apartment with eight, 10, 12, 14 guys in it, on roll-out mattresses and sleeping on the floor, sleeping on the couch, sleeping in bunk beds, air mattresses, waiting in line for the shower." Such quarters are known colloquially as "crash pads."

Roger Cohen, speaking for the Regional Airline Association, responds: "Let's get the facts out on the table on this, Miles. The average salary for a regional airline captain is $73,000. The average salary for a first officer at a regional airline is about $32,000, $33,000 a year." To O'Brien's suggestion that regional airline pilots paid less than the average are in "an untenable position economically," Cohen replies, "Absolutely not, because there are many other people who earn less money than that, who work more days in these communities, that can afford it … and do it responsibly."

"Growth of Regional Airlines" describes Colgan Air's growth from a fixed-base operator to a charter company and, with deregulation of the airline industry, to a regional carrier. An explanation of changes in the industry's business model, the hub-and-spoke concept and development of code sharing leads to a discussion about financial pressures facing airlines. "The major airlines created regional airlines as a way of controlling costs," Prater says. (Voss commented on cost controls and safety in *ASW*, 2/10, p. 1.)

"The Life of a Regional Pilot" peers into the lives of regional pilots in which the workload is challenging, days are long, lengthy commutes to work are the norm, hourly pay is low, and time on duty does not correspond to time paid, according to the program.

"Who's Responsible for Safety" says, "Some major airlines don't take responsibility for safety of their regional partners — they rely on the FAA. Is that agency up to it?" Congressional hearings raised questions about who takes responsibility for safety — major airlines or their contractual regional airlines. Questions about the FAA's mandate and its relationship with the airlines it regulates are explored.

"A Decade of Missed Warning Signs" reveals documents, interviews and conversations intended to support the program's assertion that "the FAA was aware of significant and repeated safety concerns at Colgan Air" and raises questions about safety culture within the airline.

"Raising Safety Standards at Regionals" discusses government and industry recommendations and public comments that have resulted from the accident about pilot training and qualifications, pilot work rules, best practices, audits and other safety issues. (Additional information about the FAA's "call to action" plans appear in *ASW*, 2/10, p. 36.)

The video is accompanied by a companion Web site produced by WGBH and contains several special features that are not included in the program, such as two short videos about work hours, rest/fatigue issues and operational pressures on pilots of regional carriers. There are expanded interviews with regional pilots, government regulators, industry representatives, family members of victims, and others. A map of regional airlines flying into and out of major U.S. airports displays airline safety records.

An online discussion includes extended consideration of the issues raised by the Colgan

'The major airlines created regional airlines as a way of controlling costs.'

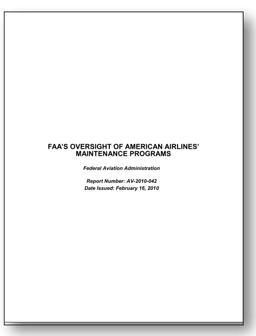
Air Flight 3407 crash. Participants include Chris Wilken, former Colgan pilot; Loretta Alkalay, former FAA regional counsel; Mary Schiavo, former inspector general, U.S. Department of Transportation; Scott Maurer, father of Lorin Maurer, who was killed in the accident; and Rick Young, writer, producer and director of "Flying Cheap."

For readers unfamiliar with PBS or *Frontline*, the corporate facts section provided on the PBS Web site, <www.pbs.org>, says that "PBS is a private, nonprofit corporation, founded in 1969, whose members are America's public TV stations." Programs distributed to PBS member stations for broadcast are produced "by PBS stations, independent producers and other sources around the world. PBS does not produce programs."

Frontline is produced by WGBH, <www.wgbh.org>, a Boston public media network, and describes itself as "the only regularly scheduled long-form public affairs documentary program series on American television." It provides "engaging documentaries that fully explore and illuminate the critical issues of our times," the Web site says.

— *Patricia Setze*

REPORTS


FAA'S OVERSIGHT OF AMERICAN AIRLINES' MAINTENANCE PROGRAMS

Federal Aviation Administration

Report Number: AV-2010-042
Date Issued: February 16, 2010

Oversight Overlooked

FAA's Oversight of American Airlines' Maintenance Programs

U.S. Department of Transportation, Office of Inspector General (OIG). AV-2010-042. Feb. 16, 2010. 27 pp. Figures, exhibits, appendix. Available via the Internet at <www.oig.dot.gov/library-item/5268>.

"American Airlines, one of the world's largest passenger airlines, has not experienced a fatal accident in eight years," the report says. "Despite this safety record, we received a complaint in February 2008 alleging that the overall operational reliability of the airline's aircraft had diminished and that previously reliable aircraft systems were regularly failing. Specifically, the complaint included 10 maintenance-related allegations and highlighted several incidents, including three flights that the complainant alleged had experienced cockpit windshield failures." Additional maintenance-related complaints were submitted.

In response, the OIG audited the U.S. Federal Aviation Administration's (FAA's) oversight of American Airlines' maintenance program between June 2008 and December 2009. The audit work was performed at FAA headquarters and the FAA Certificate Management Office (CMO) for American Airlines in Fort Worth, Texas. FAA inspectors and analysts were interviewed, as were officials at American Airlines headquarters.

"FAA's oversight of American Airlines' maintenance program lacks the rigor needed to identify the types of weaknesses alleged by the complainant — at least four of which were confirmed and have potential safety implications," the report says.

"First, we confirmed the allegation that American Airlines' maintenance-related events have increased," the report says. "Further, the National Transportation Safety Board (NTSB) recently found that American's Continuing Analysis and Surveillance System (CASS) — a system intended to monitor and analyze the performance and effectiveness of a carrier's inspection and maintenance programs — failed to detect repeated maintenance discrepancies, which, if found, could have prevented an in-flight engine fire that occurred in September 2007."

According to the report, in the 13 days prior to the accident involving American Airlines Flight 1400, the aircraft's left engine air turbine starter valve had been replaced six times because of an engine-start problem, but to no avail. The report says that the issue was not recognized by the airline's CASS personnel.

"While we did not identify any immediate safety-of-flight issues, our analysis of maintenance-related incidents at American Airlines found that the carrier's overall operational reliability has decreased since 2004, which increases the risk of serious incidents," the report says. "The rate of operational events across all fleets — including cancellations, in-flight diversions and other delays — rose from 3.9 events per 100 departures in January 2004 to 5.8 events per 100 departures in December 2008."

The OIG confirmed the allegation that maintenance deferrals had increased significantly. "From 2004 through the first five months of 2008, American's number of open maintenance deferrals increased by 32 percent, from an average of 298 per day to an average of 394 per day," the report says. "Despite this increase, FAA only tracked the number of deferrals but did not identify the types of aircraft parts being deferred or the causes of the deferrals."

The report adds that from January 2007 to the end of the study period, the airline submitted at least 13 self-disclosures concerning improper use or issuance of minimum equipment lists (MELs). Examples included deferring maintenance on a navigational component that was not listed in an MEL, which therefore could not legally be deferred.

The audit also "confirmed the allegation that American was not following procedures for required maintenance inspections. We found that FAA has not taken appropriate action to address American's longstanding failure to comply with required maintenance inspection procedures."

The report cites the FAA's failure to force American Airlines to comply with procedures for required inspection items (RIIs): "American has a history of noncompliance with RII requirements. For example, in 2007, American self-disclosed nine noncompliances — three disclosures involved expired technician qualifications, and six disclosures related to RII inspections that were not conducted."

In May 2006, a System Analysis Team (SAT) formed of FAA and airline representatives made 35 recommendations, including promptly notifying employees whose qualifications were about to expire. "Despite the SAT's numerous recommendations, we confirmed the allegation that an American Airlines technician with an expired authorization performed an RII inspection on the fire-damaged MD-80 [from the September 2007 engine fire] after mechanics had performed significant repairs on the aircraft," the report says. "American did not discover the RII noncompliance until the aircraft had been returned to service and was at a gate ready to depart with passengers." According to the report, American Airlines officials said that by December 2009, the airline had implemented all but one SAT recommendation; that recommendation was to be implemented in April 2010.

The report says, "According to FAA's principal maintenance inspector, FAA will continue to monitor American's compliance with RII requirements until it is satisfied that a long-term corrective action is in place. To date, however, FAA's actions have not elicited confidence that its oversight is sufficient. For example, in response to the RII allegation, the CMO assigned one inspector to review only one MD-80 aircraft — even though the MD-80 fleet is American's largest, with 279 aircraft."

The airline submitted at least 13 self-disclosures concerning improper use or issuance of minimum equipment lists (MELs).

Finally, the report said, "We confirmed the allegation that American did not implement a Boeing service bulletin alerting carriers to problems with aircraft windshield heating systems that could cause the windshield to crack or shatter if left uncorrected."

The service bulletin, issued in 2006, concerned the Boeing 757 and instructed air carriers on how to correct the problem, which if not attended to could cause a component to overheat, possibly leading to smoke in the cockpit and a cracked or shattered windshield.

"Although American took steps to implement the inspections, neither FAA nor the carrier ensured the mechanics performed the work," the report says. "For example: The engineer responsible for drafting the engineering change order — which is required to issue work cards to mechanics — left the company, and the order was never released. Without the order, American personnel could not issue work cards instructing mechanics to perform the work."

The report points out that the service bulletin was not a requirement, and even had it been followed, correcting the identified problem would not have prevented a January 2008 incident as the complainant alleged. In that incident, a 757 crew made an emergency landing after the cockpit filled with smoke, and the inner pane of the copilot's windshield shattered, blocking visibility.

"However, service bulletins often highlight safety issues that lead to the issuance of an airworthiness directive," the report says. "While an airworthiness directive has not been issued, Boeing stated that the bulletin did have safety implications based on prior incidents and that all carriers were expected to comply." The report adds that "since the January 2008 incident and subsequent February 2008 allegations, American and FAA have initiated or taken actions to address windshield heating system concerns."

The FAA assembled an internal assistance capability (IAC) team to review independently the February 2008 allegations and the CMO also conducted a review. "However, neither review was comprehensive," the report says.

The OIG recommends that the FAA:

- "Begin a review of American's CASS and reliability system to ensure that problems are identified and needed improvements are made;
- "Conduct comprehensive inspections of the allegations regarding operational reliability, MELs, RII requirements and windshield inspections;
- "Improve data analyses by requiring the CMO analyst and inspectors to regularly and thoroughly review available operational reliability data, track the types of maintenance items that are deferred, closely monitor trends in maintenance deferrals, and identify reasons for any significant negative changes in reliability or increases in deferrals;
- "Issue the proposed airworthiness directive that would require implementation of the Boeing service bulletin on repairs to windshield heating components on 757s;
- "Improve the independent review process by (a) performing verification work at air carriers rather than just reviewing FAA inspection records and ensuring that the review results are shared with the office under review, [and] (b) coordinating all safety-related independent reviews conducted using the IAC process through its new Office of Audits and Evaluations; [and,]
- "Determine why FAA's oversight did not identify the weaknesses discussed in this report and whether these are agency-wide issues or limited to American's CMO."

The FAA concurred with the first five recommendations and partially concurred with the last.

— *Rick Darby*

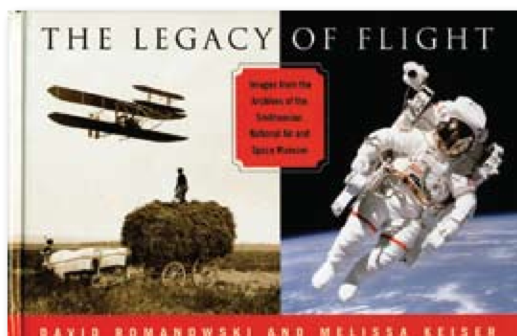
BOOKS

It's a Snap

The Legacy of Flight: Images from the Archives of the Smithsonian National Air and Space Museum

Romanowski, David and Melissa A.N. Keiser. Piermont, New Hampshire, U.S.: Bunker Hill Publishing, 2010. 288 pp. Photographs, index.

Photography was well established by the beginning of powered aviation, and the camera has served the historical record. Early "flying machines" were sensational enough to attract the attention of any photographer who happened to be nearby, and many photographers ever since have found that aviation offers dramatic subjects.



The Legacy of Flight includes 132 photographs that illustrate flight's development, through peace and war, into the space age. The emphasis is on people — both famous and anonymous — as much as the equipment. An accompanying page of text offers commentary about each photo.

— *Rick Darby*

Takeoff Rejected Well Above V_1

Incorrectly trimmed stabilizer resisted rotation.

BY MARK LACAGNINA

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

JETS

Breaks in Routine Distracted Pilots

Boeing 737-300. No damage. No injuries.

Distractions and unusual situations that interfered with normal routine led to a breakdown of standard procedures that resulted in an attempted takeoff with an incorrect stabilizer setting and a rejected takeoff 29 kt above V_1, according to the U.K. Air Accidents Investigation Branch (AAIB).

The serious incident occurred the morning of Feb. 6, 2009, at Birmingham (England) Airport. The 737 was scheduled for a round-trip flight to Edinburgh, Scotland. There were 100 passengers and five crewmembers aboard for the outbound sector. The first officer was designated as the pilot flying.

The AAIB report said that both pilots were concerned about the weather conditions at Birmingham, which included 2.5 km (1.6 mi) visibility in snow, a broken ceiling at 2,600 ft, surface winds from 350 degrees at 6 kt and a surface temperature of 0° C (32° F).

"The first officer stated to the operator when interviewed that he was less comfortable about the weather than the captain," the report said. "The captain, however, was not sufficiently aware of the first officer's concerns to decide to operate the outbound sector himself."

The crew requested that the aircraft be deiced before departure, and the deicing was begun at 0659 local time. In the prevailing conditions, the Type 2 fluid had a maximum holdover time of 65 minutes.

Per company procedure, the 737 had been parked overnight with the stabilizer at a nose-down trim setting. "It was normal practice during preflight preparations for the first officer to set the stabilizer trim to the takeoff position when the crew checked information from the loadsheet," the report said. "On this occasion, however, [the aircraft] was being deiced at the time and the trim could not be set."

After starting the engines, the pilots decided to leave the flaps up while taxiing on the slush-covered taxiways. However, they did not check the stabilizer trim setting while conducting the after-start checks. The required setting was 4.5 units, but the stabilizer was set at 2.3 units — a nose-down setting that was within the allowable takeoff range of 1.0 to 6.3 units.

The loadsheet showed a takeoff weight of 46,766 kg (103,100 lb), or about 9,700 kg (21,385 lb) below the 737's maximum takeoff weight. The pilots had calculated V_1 as 126 kt and V_R, or rotation speed, as 132 kt.

V_1 is defined by regulations as "the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance" and as "the minimum speed in the takeoff, following a failure of the critical engine at V_{EF}, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance." V_{EF} is the speed at which the critical engine is assumed during performance certification to fail during takeoff.

The report did not specify the calculated takeoff distance. Runway 15/33 at Birmingham is 2,600 m (8,530 ft) long.

As the 737 was taxied to the runway, the snowfall intensity increased, and the captain decided to reduce the holdover time to 40 minutes, which would require that the aircraft be deiced again if it did not depart by 0739.

The captain told investigators that he felt pressure to depart before the deicing fluid holdover time expired. "This was compounded by the ATC [air traffic control] taxi clearance that required them to taxi the longest route to the holding point and caused the aircraft to be at the back of the queue on arrival," the report said. "While they focused on selecting takeoff flap prior to departure, they did not notice the incorrect trim setting."

The takeoff was begun two minutes before the holdover time expired. At V_R, the copilot applied normal rotation force on the control column. "He doubled his effort after his first attempt had no effect," the report said. "The captain was aware that there was no rotation and decided to stop the aircraft."

The captain felt pressure to depart before the deicing fluid holdover time expired.

Airspeed was 155 kt when the pilots brought the throttles to idle and proceeded with the rejected takeoff procedure. "The speed was under control with 900 m [2,953 ft] of runway remaining, which allowed braking to be reduced, and the aircraft vacated the runway at the upwind end," the report said.

Aircraft rescue and fire fighting personnel inspected the 737's wheel brakes and, finding no sign of fire, told the pilots that they could proceed to the stand. While taxiing, the pilots noticed the incorrect trim setting.

They told investigators they had believed that the inability to raise the aircraft's nosewheel at V_R was the result of a flight control problem. "Both crewmembers were concerned about the weather conditions and taking off at the limit of the deicing holdover time," the report said. "When the captain saw the lack of rotation, his concerns about possible ice accretion were reinforced, and [believing the aircraft was incapable of flying] he made the decision to reject the takeoff even though the speed was, by then, well above V_1."

Tests in a flight simulator indicated that the nosewheel could have been raised at V_R if the copilot had pulled more forcefully on the control column. "The results also showed that rotation was achievable and that the aircraft could have climbed away safely," the report said.

Glass Cockpit Darkens

Dornier 328-300. Minor damage. No injuries.

Investigators were unable to determine the root cause for the failure of all five electronic flight displays during a ferry flight from Biggin Hill, England, to Southampton the afternoon of March 3, 2009.

The AAIB incident report said that the aircraft had been stored in a hangar for about a year after the tail section was repaired following an accident. It had been flown only three hours during that time, although regular engine ground runs and routine maintenance had been performed.

About 20 minutes into the ferry flight, the Dornier was in instrument meteorological conditions (IMC) at 8,000 ft when the no. 1 multifunction display failed. Over the next 15 minutes, the no. 2 multifunction display, both primary flight displays and the engine indicating and crew alerting system display went blank.

The flight crew used the standby instruments to conduct a localizer approach to Southampton Airport and landed the aircraft without further incident.

The display failures were traced to malfunctions of the transformers in the high-voltage power supplies. "The transformers were epoxy-encapsulated, and the potting around the secondary winding [in each transformer] had failed, most likely due to overheating, causing the winding to short-circuit," the report said.

To prevent damage from overheating, the display manufacturer recommends avoidance of sustained operation when cockpit temperature exceeds 40° C (104° F). However, investigators concluded that it is unlikely the incident aircraft had been exposed to such temperatures.

The displays were replaced, and, following no sign of recurrence of the problem, the aircraft was returned to service.

"Given the lack of any additional findings from inspection of the incident aircraft, it has not been possible to determine a common trigger mechanism for the possible overheat and breakdown of the [transformer] potting, although investigations into the failure of other units in the world fleet may lead to a definitive cause being identified," the report said.

Similar display failures have occurred recently in three other Dornier 328s during ground operations. "All three aircraft had been subject to extended periods without airborne operation," the report said.

Airplanes Backed Into Each Other

Boeing 757-300, 737-800. Substantial damage. No injuries.

Night visual meteorological conditions (VMC) prevailed when the airplanes collided while being pushed back from gates facing each other at Seattle-Tacoma (Washington, U.S.) International Airport on Dec. 28, 2008.

The 757 flight crew had requested and received clearance for pushback first, said the report by the U.S. National Transportation Safety Board (NTSB). Shortly thereafter, the 737 crew requested clearance for pushback, reporting that they were at Gate 11. The ramp controller, however, thought that the 737 crew had requested clearance for pushback from Gate 14, and she issued clearance for pushback.

After pushback, the 737 was in the ramp alleyway facing north with the parking brake set. The flight crew was starting the no. 2 engine and the ground crew was disconnecting the tow bar when they felt the airplane shudder. "The tug operator and [his] assistant immediately ran toward the rear of the 737 and observed [the 757] immediately behind the 737," the report said.

The 757 was being pushed back into the alleyway to face south when the flight crew "felt what appeared to be the nosewheel sliding slightly on the wet ramp," the report said. Neither the flight crew nor the ground crew realized that a collision had occurred. The ground crew disconnected the tow bar and returned to the gate.

The 757 crew observed, and cleared, a status message about the left elevator. They told investigators that "everything appeared normal." Shortly thereafter, the ramp controller told the crew that a collision had occurred.

Data from a security surveillance camera showed that the 737 was stationary for 36 seconds before the collision occurred. The airplanes, which were operated by different airlines, both received substantial damage to their left elevators.

The probable cause of the accident was "the failure of the tug operator and wing walker of [the 757] to maintain clearance with the other airplane," the report said. "Also causal was the ramp controller's misinterpretation of the [737's] gate location and her improper clearance for both airplanes to simultaneously push back from nearly opposing gates."

Neither the flight crew nor the ground crew of the 757 realized that a collision had occurred.

Hard-Landing Damage Not Detected

Airbus A321-231. Substantial damage. No injuries.

The A321 was inbound to Manchester, England, on a charter flight from Spain the night of July 28, 2008. The copilot, the pilot flying, initiated the landing flare early, and the aircraft began to float about 10 ft above the runway.

"While in the float, the copilot's sidestick moved to full forward then to full aft," the AAIB report said. "The aircraft reacted with a rapid nose-down pitch and touched down [nosegear-first] in a near-flat attitude. A significant bounce occurred, which was controlled by the copilot; a second touchdown and rollout ensued."

The commander taxied the aircraft to the stand, where the 159 passengers disembarked normally. "Three passenger service unit oxygen masks had dropped from their stowages, but no other effects of the landing were apparent," the report said.

When the flight crew told a company engineer about the hard landing, they expressed certainty that there had been some damage. However, the on-board data system had not generated a printed structural exceedance report based on recordings of excessive rate of descent and vertical acceleration on touchdown.

The engineer checked the data management unit (DMU) to determine if a report had been stored but not printed. "The DMU did not contain any such report; consequently, the engineer concluded that the landing could not have been as hard as the crew suspected [and that] no inspection was required," the report said.

Nevertheless, because of the crew's concern about damage, the engineer performed a visual inspection of the aircraft. He found no sign of damage, so the oxygen masks were restowed and the A321 was released for service.

Later that night, another flight crew was unable to retract the landing gear while departing from Manchester. They returned to the airport and landed without further incident.

The engineer concluded that the landing could not have been as hard as the crew suspected.

"Subsequent inspection of this defect identified internal damage to the nose landing gear and a bent proximity switch link rod," the report said. "The [nosegear] was replaced and extensive inspections were conducted before the aircraft was released to service."

Among recommendations prompted by the investigation, the AAIB called on Airbus to review on-board data system parameters to ensure that a report is issued whenever there is a potential for damage from a hard or overweight landing, or from an abnormal landing such as a nosewheel-first touchdown.

Broken Slat Track Causes Control Problem

Boeing 737-200. Substantial damage. No injuries.

The 737 was en route the afternoon of Dec. 29, 2007, from Brisbane, Queensland, Australia, to Norfolk Island, where VMC with temporary visibility and ceiling reductions was forecast. On arrival, visibility was 3,000 m (about 1 3/4 mi), the ceiling was at 500 ft, and surface winds were from the east at 20 kt, gusting to 35 kt.

The flight crew conducted the VOR (VHF omnidirectional radio) approach to Runway 11, according to the report issued in February 2010 by the Australian Transport Safety Bureau (ATSB).

The aircraft was 2 nm (4 km) from the airport when the crew established visual contact with the runway. They determined that excessive maneuvering would be required for a straight-in landing and circled over the ocean to enter a base leg. "As the aircraft was turned through the base leg and onto final approach, the visibility deteriorated, and a missed approach procedure was conducted," the report said.

While retracting the flaps, the crew felt a high-frequency vibration and saw the control yokes deflect to the left. The control deflection increased to about 40 degrees, and the autopilot disengaged automatically.

"Controlled flight was maintained manually by the crew with difficulty," the report said. "There were no other cockpit indications to assist the crew to identify the problem. The cabin crew reported that they also noticed that the aircraft was shaking and vibrating, similar to the effect of flying through cloud and turbulence."

The pilot-in-command (PIC) asked the cabin manager to look out the cabin windows for any anomalies. The cabin manager reported that a leading-edge slat on the right wing was protruding at an unusual angle and showed the pilots a photograph made with a mobile telephone.

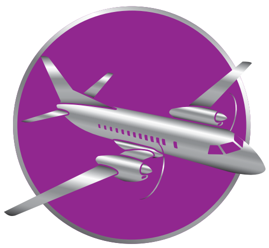
The flight crew declared an urgency (pan) and diverted to their designated alternate airport at Nouméa, New Caledonia. Concerned about controllability and the effects on performance and fuel consumption from the aerodynamic drag created by the protruding slat, the PIC told the cabin crew to prepare the passengers for a possible ditching.

Lacking a checklist for the situation, the crew decided to cycle the flaps. This reduced the protrusion of the no. 4 slat; the vibration decreased slightly, and performance and controllability were improved. The 737 was landed in Nouméa without further incident.

There were no injuries during the flight, but "a number of passengers reported psychological issues and resultant physical problems following the flight," the report said. "That included one passenger who suffered two seizures after disembarkation at Nouméa."

Examination of the 737 revealed that the inboard main track for the no. 4 leading edge slat had fractured at mid-span. "An examination of the failed track identified fatigue cracking that originated at the intersection of diverging machining marks at the fracture site," the report said.

TURBOPROPS



'Competing Tasks' Cited in Control Loss

Beech 1900C. Destroyed. One fatality.

VMC prevailed for the single-pilot cargo flight from Honolulu, on the island of Oahu in Hawaii, U.S., to Lihue, on Kauai, the night of Jan. 14, 2008. The airplane was nearing the destination from the south at 2,000 ft when ATC verified that the pilot had both the airport and a preceding Boeing 737 in sight.

The controller then cleared the pilot to follow the 737 for a visual approach, terminated radar services and told the pilot to change to Lihue's common traffic advisory frequency.

Recorded ATC radar data "showed that the pilot altered his flight course to the west, most likely for spacing from the airplane ahead, and descended into the water as he began a turn back toward the airport," said the NTSB report.

The accident occurred about 6 nm (11 km) south of the airport. Most of the wreckage sank in 4,800 ft of water and was not recovered. The pilot was not located and is presumed to have been killed.

The report said that the pilot had been confronted with the "competing tasks" of monitoring his airplane's instruments, lining up with the runway and maintaining separation from the 737. This resulted in vulnerability to visual and vestibular illusions, and reduced awareness of his airplane's attitude, altitude and trajectory.

"The pilot most likely descended into the ocean because he became spatially disoriented," the report said. "Although VMC prevailed, no natural horizon and few external visual references were available during the visual approach."

Undetected Crack Causes Wheel Fracture

Saab 340B. Substantial damage. No injuries.

During a post-flight inspection of the aircraft in Sydney, New South Wales, Australia, the afternoon of Feb. 9, 2009, the flight crew noticed that the outboard tire on the left main landing gear was deflated and the wheel assembly was damaged.

"The crew reported that there had been no prior indication of any problems with the aircraft, with normal handling during the landing and taxiing phase of the flight," said the ATSB report.

During an examination of the 340, maintenance personnel found that about one-half of the circumference of the wheel rim had fractured but was still attached to the wheel assembly. Damage to the axle and brake assembly also was found, and replacement of the entire left main landing gear was required before the aircraft was returned to service.

The wheel had accumulated 252 hours of service and 298 cycles since its last overhaul. Investigators found that the wheel design was being phased out because of known fatigue cracking at the rim bead seat area. "Both the manufacturer and the operator were aware of the increased fatigue susceptibility of the earlier wheel design and had established increased inspection regimes for those wheels remaining in service," the report said.

The investigation concluded that the fatigue crack likely was in the incipient stage and had not been detected during the last eddy current inspection of the failed wheel.

Gyro Problem Precedes Breakup

Jetprop DLX. Destroyed. Five fatalities.

The aircraft, a turboprop conversion of the Piper Malibu, was en route on a private flight from Edmonton, Alberta, Canada, to Winnipeg, Manitoba, the morning of March 28, 2008. Shortly after the aircraft leveled off at its assigned altitude, Flight Level 270, ATC radar showed that it was climbing.

"When contacted by the controller, the pilot reported autopilot and gyro/horizon problems and difficulty maintaining altitude," said the report by the Transportation Safety Board of Canada (TSB). "Subsequently, he transmitted that his gyro/horizon had toppled and could no longer be relied on for controlling the aircraft."

ATC radio and radar contact were lost after the aircraft made several heading and altitude changes, and began a steep descent that accelerated to more than 30,000 fpm. "On final descent, the groundspeed dropped [from 260 kt] to 100 kt, indicating a near-vertical flight path," the report said.

An emergency locator transmitter signal was detected, and the Royal Canadian Mounted Police found the wreckage 16 nm (30 km) northeast of Wainwright, Alberta, about four hours later. Examination of the aircraft showed that both wings and the vertical and horizontal stabilizers had failed in flight.

Investigators determined that the aircraft was about 712 lb (323 kg) over its maximum gross weight and that the center of gravity was about 0.87 in (2.21 cm) beyond the aft limit when the accident occurred.

"The vacuum system appeared to have been operating normally, although possibly at a lower setting than specified by the manufacturer due to an over-reading gauge," the report said.

Before the accident flight, an instrument repair shop had recommended replacement of the attitude indicator because of noisy bearings and unstable output signals to the autopilot. The attitude indicator had been in service for 1,200 hours.

The pilot, an executive for the company that owned the airplane, had logged about 987 of his 2,200 flight hours in the Jetprop. He had passed an instrument proficiency check in December 2007. Partial-panel exercises were not included, and were not required to be included, in the check. Records indicated that the pilot's last partial-panel training was conducted in May 2001.

Based on these findings, TSB said, "Many high-performance aircraft in Canada are operated in [instrument] conditions by single pilots. The board is therefore concerned that without either additional instrument redundancy, partial-panel currency, or both, there is a risk that this type of accident will be repeated."

PISTON AIRPLANES

Electrical Failure Endangers Ferry Flight

Cessna 421B. Substantial damage. No injuries.

The 421's airworthiness certificate had expired, and the operator had received a permit to conduct a visual flight rules (VFR) ferry flight from Indore, India, to Shivpuri the morning of March 21, 2009. About 15 minutes after takeoff, a total electrical failure occurred, said the report by India's Directorate General of Civil Aviation.

The aircraft was 30 nm (56 km) from Bhopal when the pilot told his passenger, the chief instructor for the operator's flight school, to use his mobile telephone to inform the ATC facility at Bhopal Airport of their situation, their position and their intention of proceeding to Shivpuri.

After receiving the information, ATC instructed the pilot to land at Bhopal, but there was no reply.

The pilot used a hand-held global positioning system receiver to navigate to the Shivpuri airport, which is uncontrolled and has a 2,800-ft (853-m) runway. On approach in VMC, he extended the landing gear manually but could not extend the flaps. The 421 floated during the flare and touched down about 800 ft (244 m) from the threshold. "At around 150 ft [46 m] from the runway end, the aircraft swung toward the left, probably due to pilot inputs," the report said.

The main landing gear separated, the nosegear collapsed and the engines and fuselage were damaged when the aircraft veered off the runway and struck a ditch. There was no fire, and the pilot and passenger escaped injury.

The report said that the electrical failure occurred because the pilot did not reset the alternator circuit breakers before takeoff. With the alternators off line, the battery was drained of charge.

Lack of recent experience in the aircraft was a factor in the accident, the report said. The pilot had logged 250 of his 11,600 flight hours in type. However, he had not flown a 421 during the 18 months preceding the accident and had not received the required refresher training.

Low Pass Ends With a Stall

Piper Chieftain. Destroyed. One fatality.

The pilot was conducting a VFR, single-pilot positioning flight from Sept-Îles, Quebec, Canada, to Wabush, Newfoundland and Labrador, for a medical evacuation flight the morning of April 1, 2007. About 30 minutes after departure, he turned off the route and flew to Grand lac Germain, Quebec, where he made two passes between 100 and 300 ft over a lakeshore cottage inhabited by friends.

The Chieftain was in a steep climbing turn after the second pass when it stalled and descended onto the frozen lake. "The aircraft broke through the top layer of ice, which was about two inches thick, then bounced off the second layer of ice," said the TSB report.

Baggage Door Opens on Takeoff

Britten-Norman Trislander. Minor damage. No injuries.

The commander was rotating the aircraft for takeoff from Jersey Airport, Channel Islands, the morning of March 24, 2009, when he saw the nose baggage door warning light illuminate. "He decided to continue the takeoff but, at around 200 ft, saw the door open," said the AAIB report.

While the commander was turning the Trislander back to the airport, the door separated and fell into the sea. "The commander continued the approach, and the aircraft landed safely," the report said.

The baggage door was not recovered, and investigators were unable to determine conclusively why it opened. However, inspection of other Trislanders in the operator's fleet showed that their door latching mechanisms were worn and that further wear could cause the door handles to separate. The manufacturer subsequently issued a service bulletin recommending periodic inspections of the latching mechanism.

HELICOPTERS

Mechanic Left Drive Shaft Bolts Loose

Bell 206L-3. Substantial damage. No injuries.

Shortly after starting the LongRanger's engine for a ferry flight, the pilot heard a loud bang and felt a vibration. "He immediately shut down the engine and exited the helicopter," the NTSB report said. "Examination of the helicopter revealed that the tail rotor drive shaft and coupling had severed just forward of the gearbox, which resulted in substantial damage to the tail boom."

The accident occurred at Galliano, Louisiana, U.S., the morning of March 2, 2009, following maintenance that included removal of the tail rotor drive shaft from the coupling. "When the two components were reattached, the mechanic only hand-tightened the bolts, figuring additional maintenance was still planned for the gearbox," the report said.

The mechanic reinstalled the drive shaft cover but did not make a logbook entry indicating that the bolts [on the drive shaft and coupling] were only hand-tight. "Another mechanic later performed additional maintenance to the gearbox, but the bolts were not checked since the maintenance manual did not require the removal of the tail rotor drive shaft cover," the report said.

The helicopter had been returned to service after an uneventful 12-minute maintenance flight check. The accident occurred during the next engine start.

Selector Breaks During Gear Retraction

Agusta A109A. Minor damage. No injuries.

While taking off from Manchester, England, for a flight to London on May 2, 2008, the commander felt the landing gear handle rotate in his hand when he retracted the gear. He asked the copilot to check the operation of the gear system.

"When the copilot pulled on the handle prior to selecting the landing gear lever down, the handle and spindle became detached from the lever," the AAIB report said. "Several attempts were made to lower the gear by pushing down on the visible stub of the lever, but it failed to move."

The commander diverted the flight to Redhill, where the helicopter was based. He flew the 109 in a hover while discussing the situation with maintenance personnel. With fuel running low, the commander disembarked the four passengers while in a low hover, then flew to a remote area of the airport where he landed the helicopter on tires that had been placed in parallel rows.

Investigators determined that a circlip had not been inserted in its groove when the landing gear selector assembly was reinstalled following an overhaul two years earlier.

Preliminary Reports, January 2010

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Jan. 2	Kinshasa, Democratic Republic of Congo	Boeing 727-200F	substantial	3 none
The flight crew turned back when a hydraulic problem occurred on departure in heavy rain. The freighter veered off the runway during the landing.				
Jan. 5	Auberry, California, U.S.	Bell 206B-3	destroyed	4 fatal
The JetRanger was on a wildlife-survey flight when it struck a power line and crashed on a hillside.				
Jan. 5	Prospect Heights, Illinois, U.S.	Learjet 35A	destroyed	2 fatal
Day visual meteorological conditions (VMC) prevailed when the Learjet entered a steep bank, rolled inverted and crashed short of Runway 34 during a circling visual approach to Chicago Executive Airport.				
Jan. 6	Piajo, Botswana	Cessna 208B	destroyed	1 serious, 5 minor
The Caravan flipped over during a forced landing on a wet flood plain after losing engine power on takeoff.				
Jan. 8	Vail, Colorado, U.S.	Dassault Falcon 20	substantial	7 none
The landing gear collapsed when the Falcon overran the runway during a takeoff that was rejected because of a burst tire.				
Jan. 8	Pierce, Idaho, U.S.	Hughes 369D	substantial	3 serious
The helicopter touched down hard and rolled over during an autorotational landing following a loss of power during a wildlife-survey flight.				
Jan. 9	Kiev, Ukraine	Ilyushin 76T	substantial	13 NA
The cargo airplane veered off the runway shortly after touching down.				
Jan. 10	San Lorenzo Acopilco, Mexico	Agusta A109E	destroyed	6 fatal
The helicopter was on a night flight to Mexico City when it crashed in fog.				
Jan. 14	Beagle Bay, Australia	Cessna 208B	destroyed	1 minor
The airplane stalled and crashed short of the runway during an emergency landing following a precautionary engine shutdown due to low oil pressure.				
Jan. 15	Kidlington, England	Piper Navajo 31P	destroyed	2 fatal
The Navajo crashed in an open field soon after departing from Oxford Airport.				
Jan. 15	La Chaux-de-Fonds, Switzerland	Beech C90GT King Air	destroyed	2 serious, 2 minor
The King Air overran the runway and struck the localizer antenna during a rejected takeoff.				
Jan. 18	Madison, Alabama, U.S.	Beech B60 Duke	destroyed	2 fatal
The pilot was attempting to return to Huntsville after an engine failed on departure. The Duke struck treetops and crashed about 3 nm (6 km) from the airport.				
Jan. 18	Elyria, Ohio, U.S.	Mitsubishi MU-2B-60	destroyed	4 fatal
The MU-2 stalled and crashed short of the runway during an instrument landing system approach in instrument meteorological conditions (IMC).				
Jan. 19	Charleston, West Virginia, U.S.	Bombardier CRJ-200ER	minor	34 none
The airplane came to a stop in an engineered material arresting system bed after overrunning the runway during a rejected takeoff (*ASW*, 12/09–1/10, p. 5).				
Jan. 21	Tijuana, Mexico	Embraer 145LU	substantial	39 NA
The regional jet veered off the runway while landing in strong, gusting winds.				
Jan. 21	Luxembourg City, Luxembourg	Boeing 747	minor	5 none
The freighter was landed safely after its main landing gear struck and severely damaged a maintenance vehicle that was on the runway.				
Jan. 22	Sand Point, Alaska, U.S.	Beech 1900C	destroyed	2 fatal
Night VMC prevailed with winds gusting to 26 kt when the cargo airplane crashed on takeoff.				
Jan. 24	Mashad, Iran	Tupolev 154M	substantial	46 serious, 124 none
The landing gear collapsed when the airplane veered off the runway during a night landing in low visibility.				
Jan. 25	Senador José Porfirio, Brazil	Embraer Bandeirante	destroyed	2 fatal, 6 NA
The Bandeirante crashed short of the runway during the third landing attempt.				
Jan. 25	Beirut, Lebanon	Boeing 737-800	destroyed	90 fatal
Night IMC prevailed when the 737 struck the Mediterranean Sea shortly after departing from Beirut.				
Jan. 27	Horten, Norway	Robinson R44 Astro	destroyed	4 fatal
The R44 entered a spin at low altitude and plunged through the ice on a fjord.				

NA = not available

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

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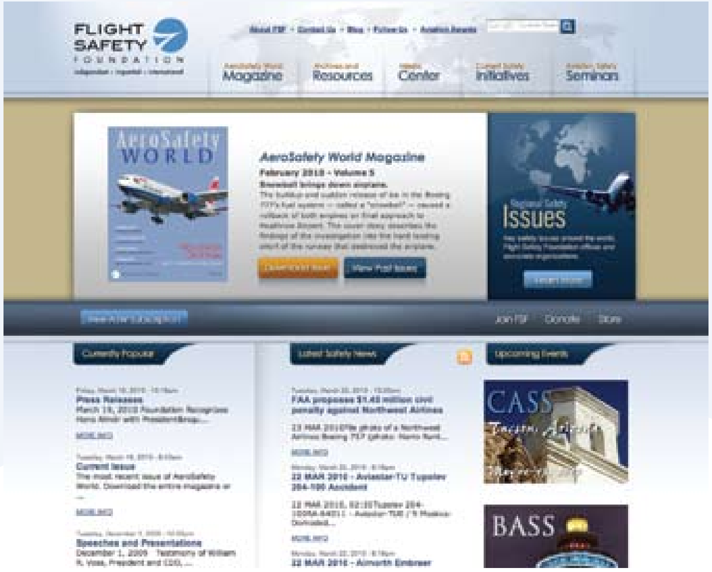

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