ISASI FORUM

"Air Safety Through Investigation"

JULY–SEPTEMBER 2007

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Aircraft recovery is made of this J41 by the airport emergency services team. While on approach to Dulles International Airport and configuring for landing, the nose gear would not extend. The crew conducted a missed approach, followed by a fly-by for observation. The crew was unable to manually lower the landing gear and elected to land with the nose gear not fully extended. Minimal damage occurred to the aircraft, and passengers were evacuated on the runway.

ISASI FORUM
"Air Safety Through Investigation"

Volume 40, Number 3

Publisher Frank Del Gandio
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ISASI Forum (ISSN 1088-8128) is published quarterly by International Society of Air Safety Investigators. Opinions expressed by authors do not necessarily represent official ISASI position or policy.

Editorial Offices: Park Center, 107 East Holly Avenue, Suite 11, Sterling, VA 20164-5405. Telephone (703) 430-9668. Fax (703) 430-4970. E-mail address isasi@erols.com; for editor, espmart@comcast.net. Internet website: www.isasi.org. ISASI Forum is not responsible for unsolicited manuscripts, photographs, or other materials. Unsolicited materials will be returned only if submitted with a self-addressed, stamped envelope. *ISASI Forum* reserves the right to reject, delete, summarize, or edit for space considerations any submitted article. To facilitate editorial production processes, American-English spelling of words will be used.

Publisher's Editorial Profile: *ISASI Forum* is printed in the United States and published for professional air safety investigators who are members of the International Society of Air Safety Investigators. Editorial content emphasizes accident investigation findings, investigative techniques and experiences, regulatory issues, industry accident prevention developments, and ISASI and member involvement and information.

Subscriptions: Subscription to members is provided as a portion of dues. Rate for nonmembers is US$24 and for libraries and schools US$20. For subscription information, call (703) 430-9668. Additional or replacement *ISASI Forum* issues: members US$3, nonmembers US$6.

AIR SAFETY INVESTIGATORS
INCORPORATED AUGUST 31, 1964

Memorial Scholarship Program Is Succeeding

By Frank Del Gandio, President

One of my most pleasurable duties is to announce the results of our annual memorial scholarship fund competition. This year that pleasure is tripled because our selection committee has named three highly promising future air safety investigators as the recipients of the ISASI Rudolf Kapustin Memorial Scholarship Fund. They are Ruth Sylvia Martin, University of Surray, Farnborough College of Technology, UK; Marissa LaCoursiere, Clarkson University, Potsdam, New York, USA; and Philip Gregory, Embry-Riddle Aeronautical University, Daytona Beach, Florida, USA.

Martin is in her final year and is pursuing an aeronautical engineering degree. She lives in Farnborough, Hampshire, England. LaCoursiere is also pursuing an aeronautical engineering degree. She is in her third year of college and lives in Lee, New Hampshire, USA. Gregory is in his final year and will graduate with an aeronautical engineering degree. He lives in Ringoes, New Jersey, USA.

Further along in this writing you will find the essay that each of them submitted and which was judged to be of sufficient superiority, each in its own right, to be declared a top submission. As you read the essays and discover the depth and variety of thought presented, think of the many yet undiscovered and talented students who are attending aviation educational institutions and who may or may not enter our professional field. Think of how our memorial scholarship fund, established in the memory of all our member comrades who served the public and the industry, can help attract to an aging ISASI individuals such as those who penned the words you will read and those past selectees who have already proved their worth by securing positions with regulatory or investigative agencies.

Then, consider if any of your annual contributory dollars could or should be directed toward nurturing your profession and Society. The memorial scholarship fund didn't exist before 2002. Its creation was triggered by the death of Rudy Kapustin, then the president of the ISASI MARC Chapter, an NTSB investigator of many catastrophic, high-visibility accidents and holder of a renowned reputation among "tinkickers." Upon his death in April 2002, his family and his Chapter proposed the establishment of a memorial fund in his honor and made a seed contribution of $2,500. Your International Council had been seeking ways to entice a greater number of students to ISASI. At its May 2002 meeting, the Council merged the two ideas and after lengthy discussion determined to formally establish an ISASI memorial scholarship fund, to honor all deceased members. The fund would be administered by the ISASI vice-president and executive advisor and would be funded by donations made to ISASI in the names of deceased members.

At its October 2002 meeting, the Council formally established the memorial scholarship fund dedicated to the memory of all deceased ISASI members. However, to recognize the impetus of the fund's creation, it was titled the ISASI Rudolf Kapustin Memorial Scholarship Fund. Contributions to the Fund, which are tax-deductible in the US, may be made in the name of a specific deceased member. The scholarship's charter stipulates that donors and recipients will be advised if and when donations are made in honor of a particular individual.

One of my most pleasurable duties is to announce the results of our annual memorial scholarship fund competition. This year that pleasure is tripled because our selection committee has named three highly promising future air safety investigators.

Present ISASI administrators are Richard Stone, executive advisor, and Ron Schleede, vice-president. Paul Mayes was involved in the initial development of the Fund's structure. Deadline for filing of applications generally occurs in early spring of each year. The two administrators ensure that the education program is at an ISASI-recognized school and applicable to the aims of the Society, assess the applications, score the competitive writing submission, and determine the most suitable candidate(s). Tom McCarthy, the ISASI treasurer, exercises oversight of expenditures.

The purpose of the scholarship is to encourage and assist college-level students interested in the field of aviation safety and aircraft occurrence investigation. Applicants enrolled as full-time students in an ISASI-recognized education program, which includes courses in aircraft engineering and/or operations, aviation psychology, aviation safety and/or aircraft occurrence investigation, etc., with major or minor subjects that focus on aviation safety/investigation, are eligible for the scholarship. A student who has received the annual ISASI Rudolf Kapustin Memorial Scholarship will not be eligible to apply for it again.

Full application details may be found on the ISASI website (www.isasi.org). In general, ISASI makes an award of $1,500 to each student who wins the competitive writing requirement, meets the application requirements, and who registers to attend the ISASI annual seminar. The award will be used to help cover costs for the seminar registration fees, travel, and lodging/meals expenses. Any expense above and beyond the amount of the award is paid by the recipient. In addition, the following are offered to the winner(s) of the Scholarship.

The purpose of the ISASI Rudolf Kapustin Memorial Scholarship Fund is to encourage and assist college-level students interested in the field of aviation safety and aircraft occurrence investigation. Applicants enrolled as full-time students in an ISASI-recognized education program, which includes courses in aircraft engineering and/or operations, aviation psychology, aviation safety and/or aircraft occurrence investigation, etc., with major or minor subjects that focus on aviation safety/investigation, are eligible for the scholarship.

- A 1-year membership to ISASI.
- The Southern California Safety Institute (SCSI) offers tuition-free attendance to any regularly scheduled SCSI course. This includes the 2-week aircraft accident investigator course or any other investigation courses. Travel to/from the course and accommodations are not included. More information can be found at http://www.scsi-inc.com/.
- The Transportation Safety Institute (FAA) offers a tuition-free course. More information is available at http://www.tsi.dot.gov/.

The first award was made in 2003 to two students. Since then, nine students, including the three 2007 awardees, have received the scholarship. Past selections have already proven successful. Two are now employed in our field and a third is awaiting placement with an investigative agency in Europe. Here is an observation from Ron Schleede: "I have been sincerely impressed with the success the Scholarship program has had in generating enthusiasm in young people for the business of air safety investigation. Every winner I have met at the seminars has displayed eagerness to meet other investigators from around the world. I take note of the gleam in their eyes as they listen and learn."

The annual number of students selected is guided primarily by merit and available funds. You can help in several ways. First, talk up the scholarship availability to your contacts. We need more applicants. Second, consider making a contribution to the Fund, either in cash or services. Remember, our selectees are students: no expense accounts, no jobs, no extra cash with which to pay for related travel and living expenses to our seminars or to gifted training courses.

Corporate members in particular might consider donation of in-kind services such as air tickets or lodging expenses to travel to the seminar location or to redeem a training gift. Our Atlantic Chapter has elected to solicit donations at its well-attended spring meeting, raising more than $3,000 this year (see page 21). Indeed, ISASI itself may find that it needs to increase the cash amount of the scholarship, especially when our seminars are conducted in locations distant from the homes of those who are selected.

Below is a scholarship donation coupon. Please consider using it. We will acknowledge by letter all contributions received. ◆

ISASI Memorial Rudy Kapustin Scholarship Fund Donation Form

Each year ISASI invites worldwide university students enrolled in aviation engineering or safety curricula to apply for a grant to attend the ISASI annual seminar.

You can help educate in and direct students to aircraft accident investigation by making (US) tax-deductible contributions to the ISASI Memorial Rudy Kapustin Scholarship Fund (in memorial to all ISASI members who have died). Mark your donation in memory of a deceased friend and comrade.

Help support the future. You can make a difference.

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Card number ____________________

Expiration date ____________________

Make checks payable to: ISASI Rudy Kapustin Memorial Fund

Mail this completed form to: ISASI, 107 E. Holly Ave., Suite 11, Sterling, VA, USA 20164

Contact information: 703-430-9668; Fax 703-430-4970
E-mail: isasi@erols.com
Website: isasi.org

ISASI Rudolf Kapustin Memorial Scholarship Fund Essay By Marissa LaCoursiere

The Challenges for Air Safety Investigators

Air safety investigators face many challenges while working on an accident. An air safety investigator's job starts by visiting the scene of the accident, collecting debris and other data, taking witness statements, and reviewing air traffic control data. The investigator must then piece together the chain of events that occurred before the aircraft came to rest. Lastly, the investigator writes a summary that might include recommendations to the FAA and other authorities of what can be done in the future to break the chain of events leading to the accident. Each step of the accident investigation process has its own unique challenges.

Investigators are the third party at the scene of an aircraft accident, the first being the pilot and passengers and the second being the emergency responders. With this comes the unavoidable contamination of the scene. For example, foam is sprayed to prevent fuel fires and parts of the aircraft may be moved to allow access to anyone trapped. Biohazardous wastes, such as fuel, are cleaned up and removed. The time it takes to make the area safe for investigators can also change the site dramatically. Ice may melt or form; rain may wash small parts away from the wreckage. All contamination must be taken into account when examining the wreckage.

The location of the site also provides challenges in this stage of the investigation. Each accident site environment must be dealt with in different ways. For example, a grass strip may require a more careful search than a paved runway, as small pieces of debris can become lost in the grass. On the other hand, a paved runway may be more active and the accident must be cleaned up more quickly to allow other planes to take off and land, causing pieces to be accidentally left behind in the rush. The environment where the site is located also affects the time and effort needed to search for every piece of the debris. A field is usually more accessible than the side of a mountain. More time is spent looking through a wooded area for small pieces than a field.

The second stage occurs after the entire crash site has been documented in full, and the aircraft is brought back to a hangar where it can be reassembled and analyzed in detail in conjunction with all other facts obtained. It is during this phase that aircraft and laboratory analysis technology plays a role in the investigator's analysis. New materials, such as fiberglass and carbon composites, do not behave the same as metals during a crash. Composites can shatter or not show any damage, whereas metals may deform and break. This deformation can be seen after a crash, leading to the determination of forces applied during the accident and attitude of the aircraft during the landing. Inside the aircraft, the glass cockpit LCD screens do not record the last attitude and airspeed of the aircraft, as "steam gauge" instruments do. This lost data may be available from ATC tapes, radar tracks, or the aircraft's "black box." Without direct data, the investigator must rely on other information such as witness statements.

Witness statements, obtained at the scene of the wreckage, are inherently inaccurate. Many people do not have the technical vocabulary to explain what they saw or heard. Memories are also affected by time, retelling of events, and any new information learned that is automatically used to fill in pieces of the event not initially understood. For example, a witness who first says that the aircraft started to sound funny may later believe that they heard two engines and then only one if they learn that it was a dual-engine aircraft. This assumption, which is part of the human psychology, can throw the investigator off—if, with the same example, both engines became oxygen starved due to ice. Another challenge to obtaining and using witness statements to supplement the debris is working with many different witnesses. The pilot may be in shock after wrecking his aircraft and perhaps killing his passengers, and a child may not be able to describe events as well as an adult. Interviewing skills are not always natural and must be taught and practiced.

Throughout the process of determining the chain of events, the investigator makes assumptions of what happened. These theories must be based on knowledge of aircraft performance characteristics and previous accidents, as well as the evidence obtained in the initial stages of the investigation. A witness who says that a dual-engine aircraft sounded funny leads to the idea that there was an engine problem. Following through with this example, if the radar track shows a sudden drop in altitude, and the pilot says that there was ice build up on the leading edge of the wings, an initial theory that the engines were oxygen starved from ice build up is reasonable. On the other hand, if there was no reported ice, but the engines were recently overhauled, then the sudden drop in airspeed could be due to an engine failure. If this can not be confirmed with evidence from the engines, then the investigator needs to look at other theories. Without looking at other theories and evidence that support those theories, the determination of the true cause of the accident will be delayed. While it is necessary to make theories to narrow the scope of an investigation, the investigator must not become so focused in one area that he or she does not take into account other, possibly conflicting, evidence.

The third stage of the investigation is to recommend changes based on the chain of events to prevent a reoccurrence. These changes could include modifications to the aircraft itself, procedures around an airport, or even regulations of pilots. To be a little glib, the easiest way to prevent aircraft accidents from occurring again is to prevent all flights. As this is not desirable or practical, the investigator must make recommendations that are fact based as well as feasible. The recommendations should also consider, but not be limited by, the budget constraints of the authorities (e.g., FAA), airlines, and general aviation pilots. The FAA can not regulate every aspect of every flight, so the investigator must work with pilot associations, such as the Aircraft Owners and Pilots Association, to increase education and awareness of breakable links in the chain of events leading to common accidents. ◆

ISASI Rudolf Kapustin Memorial Scholarship Fund Essay By Ruth Martin

Air Accident Investigation: "Experience is a Hard Teacher. First Comes the Test, Then the Lesson."

Air accident investigators tackle numerous challenges in a multifaceted role, drawing upon past and present experiences to help solve and understand the complex issues surrounding an accident. The challenges they encounter are far too comprehensive to be detailed in such brief an essay. Though, when looking into the field, one thing strikes me most profoundly—how the humanistic element is intrinsically linked with almost every element of an accident. This will be the focus of this essay.

Unlike many engineering-related disciplines, air accident investigation not only involves collecting physical evidence, but also requires the ability to interact with all those involved in the accident—the engineer, pilots, passengers, and members of the public who may be witnesses. Arguably this could be perceived as one of the hardest challenges, as humans are a lot less predictable and quite complex to deal with. Every person is different. How does an air accident investigator break down the barriers of human nature, assess the psychology of an individual, and establish good communications, essential to ensure the experiences relayed to the investigator are accurate, without bias, and comprehensive? All of this must be achieved within time constraints and sometimes under extremely adverse and challenging conditions.

Experience is the accumulation of knowledge and skill that a person acquires over time while going through, or being a part of, a situation. Questioning is a vital part of gaining an understanding of someone else's experience, which may in turn ascertain the potential causes of the human factors in an accident. Very often, the experience of individuals involved in an accident is traumatic. The emotional wake they leave behind must be tremendous. From this potent cocktail of emotions, which can unwittingly distort the memory of an accident, the investigator must unearth and decipher the facts. It may be the person is unaware they have knowledge of an important fact that may be key in solving the accident. Something seemingly trivial to the person may be of great importance to the investigation. The challenge for the investigator is to decide what information is relevant, a difficult task given the sheer volume of information that can be available from those interviewed. Too much information can be just as bad as too little, in that it is immensely difficult to process.

The experience of each individual involved must be closely examined in order that others may not go through the same ordeal again, and if they do how we can be better equipped to cope with the situation. The actions, not mistakes, of one may give light to how a situation can be dealt with in the future. This can only be achieved by sound processing of the supplied information. When questioned about the accident and their role, these individuals may feel under scrutiny, at fault, or that they are being blamed for said situation, even if this is not the case. The person may be fearful of answering honestly and be defensive when questioned, affecting the answers provided. Self-preservation, consciously or subconsciously, takes over, and the individual may omit information or alter the things said, potentially jeopardizing an investigation. It is human nature, and information gleaned in this way is often open to interpretation. The investigator must be open-minded, and it is essential he or she be able to relate to a wide cross section of society.

Investigators may have to assume a character role when questioning in order to tease out the information they hope to glean. The nature of that role is governed by the psychology of the individual and may require a more direct and firm questioning approach. Gauging the state of the individual is essential in order to appropriately tease out the required information. It is imperative that the investigator knows how far to press for information, too, as some witnesses may have more information than others.

The witnesses and parties involved in an accident have been covered thus far. However, this is only the tip of the iceberg. Any accident is very distressing, and equally the humanistic aspects relating to the investigators themselves have to be considered. It may be extremely difficult for investigators to detach themselves from an accident, and even harder for them to be objective in their work. This comes to the fore most powerfully where fatalities are involved. Bearing witness to a crash site, its sights, smells, and sounds, is a very moving experience. In fact, it has been said that it is something investigators never get used to. They just learn how to cope with it. Talking to distraught relatives, survivors, and staff involved is very emotional, and it must be very difficult not to become involved. In order for the investigators to be effective, they have to learn how to cope in these situations. Good emotional well-being is essential if the work undertaken is to be thorough and impartial. Personal prejudice and opinions must be put aside, as it is not the investigators role to play judge and jury or apportion blame and liability. They exist to take a non-judgmental, neutral role in collecting the facts surrounding the accident. They only present the facts of the situation.

Learning how to deal with the issues mentioned is not easy to explain. It is something learned with personal experience, and from the experience of others. Unfortunately, experience is only something to be gained by putting yourself in the situation, the lesson if you will, or by having an empathy with colleagues and people so as to understand and learn from them. To go through an experience, learn from it, and make a difference as a result is a difficult challenge. A challenge faced by air accident investigators. ◆

ISASI Rudolf Kapustin Memorial Scholarship Fund Essay By Philip Gregory

The Challenges for Air Safety Investigators

The challenges facing air safety investigators vary a great deal in this ever-changing world.

Rapid changes frequently allow for impressive advancements that aid investigators, while at times making their job that much harder. The greatest challenge seems to be a rapid flow of information in this day and age. One can hardly live without being bombarded by news stations such as Fox News and CNN. Now, more than ever, there is increased pressure for the investigator to complete an investigation quickly, all while the eyes of the news media relentlessly watch. The news media will be quick to ask questions, and even quicker to jump to conclusions concerning the cause of an accident, looking for something spectacular. Such spectacular theorizing by the news media is often less than accurate, and occasionally taken as the only truth by some of the public. Once a theory concerning what happened comes out, it is almost impossible to dispel regardless of hard evidence. The constant stream of the news media never lets the accident out of the public eye, fueling a desire for quick answers with arm-chair debates over the Internet. Nearly everyone has access to the Internet in some form or another, which is used as a powerful medium to transmit ideas, information, and rumors.

The Internet allows a single person to broadcast opinion instantly around the world through use of chat rooms and forums, adding to the already-rampant speculation created by the news media agencies. We have seen that this information will undergo a warping process, changing gradually each time it is told. The source of the information is not accurate to begin with, so when it comes back to the investigator, it resembles little or nothing of fact. This type of misinformation needs to be corrected, as it takes valuable time and energy from the actual investigation. Perhaps the worst part of this information is the false hope it can sometimes create for the loved ones of the victims in the accident. Rumors of unconfirmed survival can spread like wildfire before investigators or first responders finish making assessments. Rumors like these are damaging, since they make people question the credibility of officials conducting the investigation. Such loss of faith is caused by the majority of people assuming that the false reports came from officials.

The news media will always be with us as a constant presence, but the public can be educated to possibly be more patient. The majority of such problems are due to the fact that the average person does not understand how or what goes into conducting accident investigations. People have a very limited view of what actually goes on when seeing small parts of an investigation as a whole. The Internet could be a great way to start addressing the public's lack of knowledge. Information is available currently on the Internet, but is not exactly designed for the average person, causing a steep learning curve. Creation of a website or source that is specifically tailored to the public may be helpful. The teaching aid should focus on a greater picture of the accident instead of the details. The most important action is exposure to the public, demonstrating how different agencies and people are involved, and the need for them to coordinate this undertaking without distraction. The National Transportation Safety Board and Federal Aviation

(continued on page 29)

Turbulence-Related Accident Investi

The author's penchant, born of being an instructor and an aircraft accident investigator, has led him to review all kinds of accident reports for self-education and teaching purposes. Here he reports on his observations regarding reportings of turbulence-related accidents.

By Gary R. Morphew, Director, Aircraft Accident Investigation, Southern California Safety Institute

(This article was adapted, with permission, from the author's presentation entitled Investigation into Turbulence-Related Accidents, *presented at the ISASI 2006 seminar held in Cancun, Mexico, Sept. 14-17, 2006, which carried the theme "Incidents to Accidents: Breaking the Chain." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

When I became an investigator, as a pilot, I understood fully the scrutiny that would be placed on the pilot flying the aircraft as well as the crew's interaction during the events that followed. By fully exploring the pilot's actions and inactions, we have, over the years, improved training, perceptions, and communication, and this has resulted in a reduction in the accident rate. We have moved far beyond "pilot error" and have found many factors that lead to the error in the first place.

Until I joined the Southern California Safety Institute (SCSI), however, I had not spent too much time looking into the role of the flight attendant other than as a valuable member of the crew during evacuations and emergencies. Now, through my association with the annual International Aircraft Cabin Safety Symposium, I have a different appreciation and, to be honest, some concerns over the analysis of the flight attendant's role in reported accidents.

In the summer of 2005, I was reading a synopsis of an NTSB investigation report involving an encounter with turbulence and a serious injury to the flight attendant on board. Nothing in particular was revealing in the synopsis until I got to the statement of probable cause. There I found a need to review the full report. The more I read, the more I became concerned that the point of the investigation had been missed by the NTSB investigator.

This concern was based on the following:

• The aircraft's captain understood the potential for an encounter with turbulence severe enough to call the lead flight attendant and tell her to expect turbulence on arrival. The discussion between them evolved into a decision to complete all the prelanding "final" cabin preparations early and to be seated.

• The lead flight attendant notified the other flight attendants, completed her portion of the prelanding preparation, and took her seat. The report indicated that the lead flight attendant was from this point "unaware" of the status of the flight attendants at the rear of the aircraft. One of these flight attendants reported he felt there was little or no sense of "urgency" in the warning.

• Ten minutes after the captain had warned the flight attendants, the aircraft encountered turbulence severe enough for the unrestrained flight attendant in the rear of the aircraft to be thrown down with sufficient force to break his leg.

By this time, I was formulating my own findings, causes, and recommendations for the report (a practice I have for evaluating all investigations). Imagine my surprise when I read the following:

The NTSB probable cause was stated as "an inadvertent encounter with turbulence." Given the circumstances I have described, what was "inadvertent" about the encounter?

• The captain gave the warning in a timely manner.

• The lead flight attendant passed on at least the substance, if not the urgency, of the warning.

• The lead flight attendant was reportedly "unaware" of the status of the other flight attendants.

It was not "inadvertent." It was expected. The actions by the flight crew were appropriate; the actions in the cabin were suspect. There must be more to the story.

I continued reading the report looking for additional information about the flight attendants. I wanted to understand the experience of both the lead and the injured flight attendants. When I evaluate a pilot's role in an event, his or her experience overall and in the specific aircraft is critical to understanding the decisions and reactions to events. I was sorely disappointed. Nothing at all was listed.

Further, when I got to the part of the report that indicated who "assisted" in the investigation, only the legally required FAA representative was identified. I was surprised that the flight attendant union was not represented.

I immediately contacted some of my friends in the flight attendant union. They

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gation Reporting

put me in contact with the specific airline's flight attendant safety representative and we discussed the event. From the union, I understood that since this was a "tabletop" investigation, one not actually involving face-to-face cooperation between the investigators, the IIC determined that the union's participation was not required and denied its petition to participate. Not only that, I found out that in contrast to the NTSB report, the airline does not utilize a lead flight attendant as a designated, assigned, crew position. Apparently, airline management determined that if it designated a crewmember to have the specific responsibility as lead, it would necessarily have to compensate the person for the additional responsibility.

To further my consternation, I learned that the senior flight attendants, who are able to pick their routes and assignments, chose not to occupy the lead position since they would not be compensated for it and, therefore, did not want the responsibility. Consequently, the position fell to the more junior flight attendants who were left that "seat" to assume the communication and coordination responsibility.

Data extraction/analysis

I decided to conduct my own research to discover whether this investigation was an aberration or just indicative of the "norm."

Using the NTSB accident database, I extracted all air carrier accident reports involving turbulence in the years 2000-2005. From this listing of some 86 reported accidents, I eliminated first all those reports that were in the preliminary investigation stage. In addition, I deleted those reports that had only the factual summary available, as I decided I needed to evaluate the probable cause as part of my investigation. Finally, I culled out any reports that, after review, did not involve an encounter with turbulence as the primary event. There were several reports in which the database search found the word "turbulence," but I found the turbulence to be cursory to the accident itself.

This left some 60 accident investigation reports for the period. In these investigations, there were some 88 flight attendants reportedly injured. In 53 cases (88.3%) of the reports, their injuries were, in fact, the reason for the investigation as the aircraft was undamaged and there were few passenger injuries. In fact, in only 7 reports (11.7%) were there only passenger injuries.

I found that in most cases (81.7%), the "seat belt" light was on indicating an anticipation of some degree of turbulence. However, we all recognize that there are many duties that flight attendants must accomplish during the normal operating periods when the passengers have been advised to remain seated with seat belts fastened.

In 28 accidents (46.7%), however, the flight deck had passed a warning for the FAs to be seated as the turbulence was expected to be beyond the normal cautionary levels. So what happens when the flight attendant receives the warning from the flight deck? In most of the cases (36.7%) where a warning had been issued by the flight deck, the lead flight attendant passed on the warning to the other flight attendants, when they were present.

In the final analysis, in only four cases (6.7%) did the NTSB find that the actions or inactions of the injured flight attendant were deficient and described in the probable cause statement. I found this to be a very surprising number. Closer analysis, however, indicated when cause was attributed to the flight attendant, in three of these four cases, the injured flight attendant had determined on his or her own when to resume cabin duties. This is significant when you factor in that the air carrier policies normally do not include any communication from the flight deck as to when the perceived danger has passed.

Most significantly to my review was the fact that of the 60 reports, I found only two cases (3.3%) in which the flight attendant organization (or union) was listed as participating in the NTSB investigation. This lent credence to the informal observation I had received earlier that the inclusion of these potentially valuable members of the investigation had been excluded.

Now, I am not saying that the union did not care or that it did not conduct its own investigation into the event. I believe the safety staff would have paid a great deal of attention to these on-the-job injuries. But without the formal identification of factors in the NTSB reports, it is increasingly difficult to share information and, eventually, change the conditions faced.

Even more surprising, I confirmed that the initial report that led me to this research was not an aberration. Three-quarters (45) of the reported accidents were attributed to turbulence alone! In fact, in nearly one-half of these cases, the NTSB determined that the encounter with turbulence was "inadvertent, unexpected, or unforecast" and that this was the primary cause of the accident.

In one-fifth (12) of the cases, the NTSB found cause with the actions of the flight crew, either in the failure to issue a warning, or failure to deviate from known weather, or even the crew's "inadvertent" entry into turbulence.

In two investigations, the NTSB found the probable cause rested with others—one a dispatcher, the other an air traffic controller—each of whom failed to relay hazardous weather information.

Again, the NTSB found only four accidents (6.7%) where the probable cause rested at least partially with one of the flight attendants. In two, the injured flight attendant removed the seat belt to attend to a cabin duty, and in another the flight attendant claimed the seat belt had not worked. In only one case was the probable cause shared with a lead FA's failure to warn the other FAs of the danger.

However, in my opinion, based on the narratives of all the investigations, at least 12 accidents (20%) were a direct result of flight attendant actions or inactions.

In these 12 cases, I felt the cause factors included

- The flight attendant who was injured or the lead flight attendant failed to understand the gravity of the expected turbulence;
- The lead flight attendant failed to communicate the warning adequately;
- The flight attendant heard and understood the warning, but continued routine cabin duties instead of securing him or herself; and/or
- The flight attendant understood the danger but left the secure seat-belted position to attend to a perceived anomaly in the cabin.

It really should be understood at this juncture, in keeping with our stated policy, that I am not putting "blame" on anyone. However, in my experience in aircraft accident investigation, human factors, and crew resource management, the necessity to accurately identify the true cause factors is essential to the accident-prevention process.

Investigation reports

Let me address my perceived inadequacy of the reports. I have no idea whether the investigator-in-charge actually evaluated the flight attendant actions or responsibilities. In some cases, I feel there probably was some consideration to it. It was interesting that in each investigation that actually had the flight attendant union participating, no cause or contributing factor ever surfaced. Further, there was never a discussion about training. I also found that none of the reports I reviewed had any discussion of the flight attendant procedures or the air carrier's corporate policies concerning turbulence avoidance or securing the cabin when warned of turbulence ahead.

Common terminology, such as the lead flight attendant, reflects nothing about the duties and responsibilities of the position. There is no discussion to define these. Do all airlines operate the same? I think not. In fact, in one report in the probable cause statement, which identified the probable cause resting with the flight attendant, the NTSB referred to this person as the "undetermined crewmember." Even after the investigation, the IIC did not know which flight attendant was injured?

Recommendations

So what do I feel must be done? First and foremost, the flight attendant unions must attempt to participate in every investigation involving an injury to one of their members. This may put a real burden on the safety staff, but the safety representatives associated with the airline can assist. If the NTSB denies participation, this fact must be documented; and if it becomes a trend, a communication to the chairman of the NTSB regarding this must be made and, if necessary, made public.

Next, the actions and inactions of all affected flight attendants must be evaluated. Even when the flightdeck crews' actions are not suspect, their flying time, years qualified as a pilot, and their duties as instructor, check airman, etc., are identified. The only time I saw a discussion regarding the flight attendants outside the aircraft referred only to where the flight attendants were domiciled. The duties and responsibilities of those placed in critical positions must be evaluated and deficiencies identified.

Additionally, if clear and unambiguous terms have not yet been developed, there should be a specific phraseology agreed upon that conveys the urgency and the danger of an anticipated encounter. If time is available, something to the effect of "clean up the cabin then be seated" should be used. If insufficient time is available to clear the cabin, some phrase like "sit down, now!" should be used. Also, there should be equally clear communication as to when the danger is down to an acceptable level—"all clear or resume duties" comes to mind.

Finally, the role of the lead flight attendant should be clearly defined and experience should count! If air carriers have not yet decided that leadership extends to activities on the passenger side of the cockpit door, then they truly do not understand the lessons learned in more than 100 years of aviation. In any operation that deals with the safety of flight, experience and training translate into advances. Air carriers are in budgetary crisis and that is well understood. Savings based on compromise of safety will never be returned when occurrences turn into incidents, or incidents become accidents.

If there is a lead position, it should have expected responsibilities. If training and experience factor into the appointment of those assigned lead positions, then compensation must naturally follow.

I have been involved in aviation for more than 40 years and in aviation safety for nearly 30; I know that investigations must be thorough and accurate if any meaningful changes are to be made. We have got to move beyond the detailed documentation of just the flightdeck personnel. When the reporting forms call only for documenting the pilots, it is not surprising that this is all we get. If the investigation does document the experience and training of all crewmembers involved, but it is not reported, the aviation community, which relies of the exchange of information in order to see trends and effect change, is denied the opportunity to learn from other's accidents.

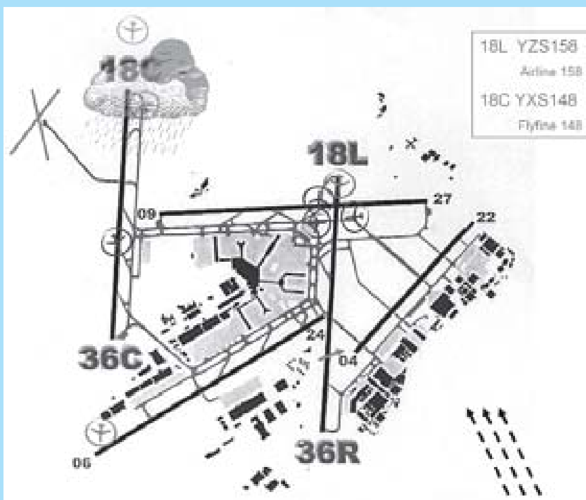
Of course, detailed investigation and reporting into the actions or inactions of flight attendants during turbulence events as well as other cabin-related safety duties will bring deficiencies to public notice. That being said, it is time for the cabin crew to experience the gains that full and accurate reporting has meant for the pilots—even when it is painful to have it identified. Positive changes will come about. It may be embarrassing, it may be difficult to accept at times, but the benefits will eventually come about.

Lastly, while my research dealt with only investigations conducted by the United States National Transportation Safety Board, I think an analysis of all governmental investigations would demonstrate that my observations are not unique to the NTSB or the United States. ◆

Threat and Error Management Framework Assists In ATC Investigations

A case study is used to illustrate how the effectiveness of draft recommendations can be evaluated by using the Threat and Error Management (TEM) framework before finalizing the investigation report.

By Bert Ruitenberg, ATC Team Leader–Tower and Approach Units, Schiphol Airport, Amsterdam



(This article was adapted, with permission, from the author's presentation entitled Using the Threat and Error Management (TEM) Framework as an Analytical Tool in ATC, *presented at the ISASI 2006 seminar held in Cancun, Mexico, Sept. 14-17, 2006, which carried the theme "Incidents to Accidents: Breaking the Chain." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

The Threat and Error Management (TEM) framework was developed by the University of Texas and is the basis for the successful Line Operations Safety Audit (LOSA) programs that have been adopted by airlines around the world. The air traffic control (ATC) community is also starting to embrace the TEM framework as the basis for a program called Normal Operations Safety Survey (NOSS), i.e., the ATC equivalent of LOSA.

Our case study occurred at the Amsterdam Airport. It was a day with frequent showers and a strong, gusty wind. There was one runway available for departures (18 left), and only one other runway available for arrivals (18 center) as opposed to two, normally. Because of the gusty wind, quite a few aircraft made a missed approach on the landing runway.

For operational reasons, one particular flight had requested permission to use Runway 18C for its departure; ATC approved the request. When the flight taxied out to the (landing) runway for its departure and was transferred from the ground control frequency to the tower frequency, the tower controller responded to the flight's first call by instructing the aircraft to hold short because "there were several departures in front." The pilots acknowledged the holding instruction.

Meanwhile, on Runway 18L, the tower controller had one aircraft lined up and waiting on the runway, several other aircraft at the regular holding points, and one aircraft at an infrequently used holding point on the other side of the runway. The airport fire brigade was crossing the runway (with clearance) in response to a minor emergency at an aircraft parking stand. The call sign of the aircraft on the runway was very similar to that of the aircraft intending to depart from 18C: YZS158 ("Airline 158") was on Runway 18L, and YXS148 ("Flyfine 148") was near Runway 18C.

After the fire trucks had crossed the departure runway (18L), the tower controller, who also was the tower supervisor that day, wanted to clear the aircraft waiting on the runway for takeoff. When giving the takeoff clearance, however, he mixed up the call sign and flight number of that aircraft with those of the aircraft near the landing runway (18C). Although he did include the correct runway identifier (18 left) in his

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clearance, the takeoff clearance was acknowledged by the aircraft near the landing runway. In their readback of the clearance, the pilots used the same runway identifier that the controller used (18 left), which in their case was incorrect for the runway they were about to enter (18 center). The aircraft subsequently departed from Runway 18C, which by chance occurred between two successive landing aircraft of which the second made a missed approach because of the wind.

At the time of this occurrence, a rain shower passed over the beginning of Runway 18C, obscuring the view of the holding point from the tower. The tower controller didn't realize what had happened until the aircraft was airborne from Runway 18C, flying in front of the aircraft that had to make a missed approach, which the controller observed on his radar display. The aircraft waiting on Runway 18L reminded the controller a few moments later that they were still lined up, after which the controller cleared them for takeoff.

Based on the information presented above, preventive measures that could be proposed include (but are not limited to) the systemic deconfliction of call signs, having a dedicated supervisor on duty, or using separate controllers for each of the runways. To find out which of those measures is potentially the most effective, the occurrence is analyzed using the Threat and Error Management framework.

Application of the TEM framework can assist in validating countermeasures that are proposed in investigation reports.

TE-based analysis

In the air traffic control adaptation of the TEM framework, threats are defined as "events or errors that occur beyond the influence of the air traffic controller, increase operational complexity, and that must be managed to maintain the margins of safety." The threats that can be identified in the case study cited above comprise (in no particular order)

1. Strong gusty wind conditions.
2. Only one landing runway available (as opposed to two, normally).
3. Several earlier missed approaches because of weather.
4. Controller also is the tower supervisor.
5. Departure from non-standard runway.
6. No extra markings for non-standard runway on flight strip YXS148.
7. No heads-up remark from ground controller with transfer of YXS148 near 18C.
8. Departure 18C to be integrated with landing traffic.
9. Departure 18L from non-standard holding point.
10. Fire engines requiring crossing the departure runway.
11. Similar company identifiers on flight strips of departing traffic (YXS and YZS).
12. Company identifiers do not resemble the corresponding call signs (Flyfine and Airline).
13. Similar flight numbers (148 and 158).
14. Acceptance and acknowledgement of clearance for incorrect runway by YXS148.
15. YZS158 doesn't challenge the clearance for the other flight to take off on 18L.
16. Beginning of Runway 18C obscured by rain shower.

The TEM framework defines error as "actions or inactions by the air traffic controller that lead to deviations from organizational or air traffic controller intentions or expectations."

The controller from the case study made the following errors:

1. Did not notice that YXS148 was at the holding point for Runway 18C.
2. Provided incorrect information ("several departures in front") to YXS148.
3. Used incorrect call sign/flight number/runway identifier combination in takeoff clearance ("Flyfine 158 cleared for take off 18 left").
4. Did not notice that the takeoff clearance was acknowledged by YXS148.

A third category in the TEM framework is that of undesired states, which are defined as "operational conditions where an unintended traffic situation results in a reduction in margins of safety." Undesired states can be managed effectively, restoring margins of safety, or the air traffic controller's response(s) can induce an additional error. Undesired states are transitional states between a normal operational state and an outcome. Outcomes can be "uneventful" in the case of successful management of the undesired state, or be a reportable occurrence (an incident or an accident) in the case of unsuccessful management of the undesired state.

The undesired states that can be identified in the case study are

1. YXS148 departing from Runway 18C on the takeoff clearance intended for YZS158 on Runway 18L.
2. YZS158 remains lined up and waiting on Runway 18L.

According to the TEM framework, there is a link between threats, errors, and undesired states. Not every threat leads to an error, and not every error leads to an undesired state, but mismanaged threats frequently lead to errors, and mismanaged errors frequently lead to undesired states. The following paragraphs explore the links for the case study:

Threats linked to errors 1 and 2

T4. Controller also is the tower supervisor.
T5. Departure from non-standard runway.
T6. No extra markings for non-standard runway on flight strip YXS148.
T7. No heads-up remark from ground controller with transfer of YXS148 near 18C.
T8. Departure 18C to be integrated with landing traffic.
T16. Beginning of Runway 18C obscured by rain shower.

Those threats were not managed and are linked to error 1 (Did not notice that YXS148 was at the holding point for Runway 18C). Error 1 was not managed and is directly linked to error 2—provided incorrect information ("several departures in front") to YXS148.

Threats linked to error 3
T11. Similar company identifiers on flight strips of departing traffic (YXS and YZS).
T12. Company identifiers do not resemble the corresponding call signs (Flyfine and Airline).
T13. Similar flight numbers (148 and 158).

Those threats were not managed and are linked to error 3—used incorrect call sign/flight number/runway identifier combination in takeoff clearance ("Flyfine 158 cleared for takeoff 18 left").

Threat linked to error 4
T14. Acceptance and acknowledgement of clearance for incorrect runway by YXS148.

This threat was not managed and is linked to error 4—did not notice that the takeoff clearance was acknowledged by YXS148.

The remaining threats from the original listing were either managed or inconsequential:
T1. Strong gusty wind conditions.
T2. Only one landing runway available (as opposed to two, normally).
T3. Several earlier missed approaches because of weather.
T9. Departure 18L from non-standard holding point.
T10. Fire engines requiring to cross the departure runway.

Errors linked to undesired states
E1. Did not notice that YXS148 was at the holding point for Runway 18C.
E2. Provided incorrect information ("several departures in front") to YXS148.
E3. Used incorrect call sign/flight number/runway identifier combination in takeoff clearance ("Flyfine 158 cleared for take off 18 left").
E4. Did not notice that the takeoff clearance was acknowledged by YXS148.

As noted earlier, error 1 was not noticed and not managed by the controller and resulted directly in error 2. That error was also not noticed nor managed, however, its outcome was inconsequential.

Error 3 is linked with threat 14 (Acceptance and acknowledgement of clearance for incorrect runway by YXS148), which in turn is linked to error 4. This last error was not noticed nor managed by the controller, resulting in an undesired state:
US1. YXS148 departing from Runway 18C on the takeoff clearance intended for YZS158 on Runway 18L.

This undesired state was not managed; the outcome was a departure from another runway than intended by the controller.

Although error 3 was not noticed by the controller, it was noticed by the crew of YZS158 on Runway 18L. This error, therefore, is also linked with threat 15 from the list:
T15. YZS158 doesn't challenge the clearance for the other flight to take off on 18L.

This threat is not managed and leads to an undesired state:

US2. YZS158 remains lined up and waiting on Runway 18L.

This undesired state is noticed by the controller after a subsequent remark from YZS158 and managed by clearing the aircraft for take off. Its outcome is, therefore, inconsequential.

Effectiveness of potential countermeasures

Now that the links between the identified threats, errors, and undesired states are established, it becomes possible to check the effectiveness of the preventive measures mentioned earlier against the list of threats. The first potential measure mentioned was the systemic deconfliction of call signs. This measure addresses the following threats:
T11. Similar company identifiers on flight strips of departing traffic (YXS and YZS).
T12. Company identifiers do not resemble the corresponding call signs (Flyfine and Airline).
T13. Similar flight numbers (148 and 158).
T14. Acceptance and acknowledgement of clearance for incorrect runway by YXS148.

The potential measure to have a dedicated supervisor on duty in reality only addresses one specific threat:
T4. Controller also is the tower supervisor.

The third potential measure mentioned, i.e., using separate controllers for each of the runways, addresses the following threats:

T5. Departure from non-standard runway.

T6. No extra markings for non-standard runway on flight strip YXS148.

T7. No heads-up remark from ground controller with transfer of YXS148 near 18C.

T8. Departure 18C to be integrated with landing traffic.

T11. Similar company identifiers on flight strips of departing traffic (YXS and YZS).

T12. Company identifiers do not resemble the corresponding call signs (Flyfine and Airline).

T13. Similar flight numbers (148 and 158).

T14. Acceptance and acknowledgement of clearance for incorrect runway by YXS148.

T15. YZS158 doesn't challenge the clearance for the other flight to take off on 18L.

T16. Beginning of Runway 18C obscured by rain shower.

Each controller would be working on a dedicated frequency, so the flights involved in this incident wouldn't be able to hear each other. YXS148 would be the only departing flight on the frequency of the controller for Runway 18C, to which the appropriate level of attention could be given especially if there was a shower over the beginning of the runway. When realizing that T1, T2, T3, T9, and T10 comprise the list of threats that were either managed or inconsequential, it is evident that this third preventive measure is the most effective one.

Hence, the TEM framework can potentially be applied in incident and accident investigation by quantifying elements in the context of air traffic control operations and by providing an understanding of the relationships between those elements. Application of the TEM framework can assist in validating countermeasures that are proposed in investigation reports. ◆

A Proactive Approach To Solving FDR Readout Problems

(This article was adapted, with permission, from the authors' presentation entitled Solving FDR Readout Problems: A Proactive Approach, *presented at the ISASI 2006 seminar held in Cancun, Mexico, Sept. 14-17, 2006, which carried the theme "Incidents to Accidents: Breaking the Chain." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

Improving FDR recording quality is only possible if most national authorities and operators commit themselves to more-stringent FDR operational serviceability requirements.

By Guillaume Aigoin and Guilhem Nicolas, Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (France)

To develop its role in improving safety, the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA, France) has progressively increased its investigation activity into incidents. A team dedicated to dealing with incidents in commercial air transport was created 3 years ago. The team's tasks include analyses of airborne recordings, either from flight data recorders (FDRs) or non-protected data recorders. To be effective, this activity requires that recordings be processed more rapidly than before. However, recorder readouts often bring to light a variety of problems such as inappropriate decoding documents or absent or badly recorded data. This may significantly block or delay the validation of the readout work and subsequently the investigation. To subdue the delay, the BEA had to overcome the FDR readout problems through a proactive approach.

Let's first look at the principles of data decoding: The FDR records information coming from a data-acquisition unit that centralizes and formats data coming from sensors, onboard computers, and other instruments. Data are recorded as binary files that are sequenced in "frames" and "subframes." Each subframe itself is divided into a number of "words," each with a fixed number of bits. Words are numbered from the beginning to the end of the subframe—the first word being called the "synchronization word" since it contains a marker indicating the start of the subframe in the binary file (see Figure 1).

As shown in the illustration, a parameter is recorded on one or several bits of one or more words. It may be recorded once or several times on every subframe, or it may be recorded on every other subframe, or with a lower frequency. The information on where a parameter's data are to be found in terms of bit numbers, word numbers, and subframe numbers is called "parameter location."

To save memory space, a parameter value is generally not recorded as such, but rather converted using a conversion function defined by the aircraft manufacturer. The reverse conversion function must be applied to the recorded parameter value to retrieve the actual parameter value. The information on the reverse conversion function is called "parameter conversion."

The data frame layout document of an FDR installation contains complete information on parameter locations and conversions so that decoding software can be programmed to retrieve any recorded parameter automatically (see Figure 2). The aircraft manufacturer or equipment installer provides the document at initial installation, and the operator is then responsible for keeping and updating it.

According to ICAO Annex 6 Part I, operators should archive all documents "concerning parameter allocation [and] conversion equations" obtained from the initial installation of the equipment. The explicit purpose is to ensure "that accident investigation authorities have the necessary information to read out the data in engineering units. JAR OPS 1 and FAR Part 125 also state that aircraft operators must keep such a document. Each of the regulations provides a list of parameters that are to be recorded and requirements on their accuracy, range, and resolutions.

Recording system operational checks

Periodic operational checks are necessary to verify that the FDR complies with re-

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***Guilhem Nicolas** also holds a masters degree in aeronautics from ENAC and a degree in human factors from the René Descartes University. Also, he has engaged in an exchange program with Embry-Riddle Aeronautical University (Florida, USA) and an internship at the NTSB regional office in Miami. Joining the BEA Safety Analysis Division in 2000 as a safety investigator, he has been involved in safety studies and has participated in international investigations. Such investigation include the Britair CRJ100 (June 2003, Brest, France) and the Air France Airbus A340 (August 2005, Toronto, Canada).*

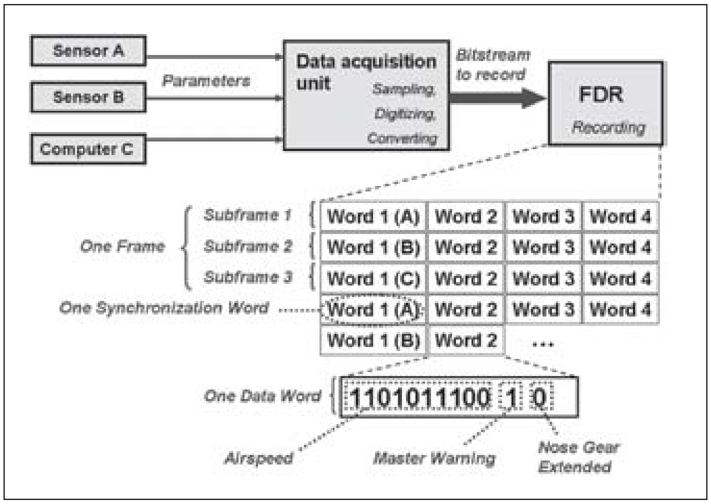


Figure 1. Parameter acquisition and coding.

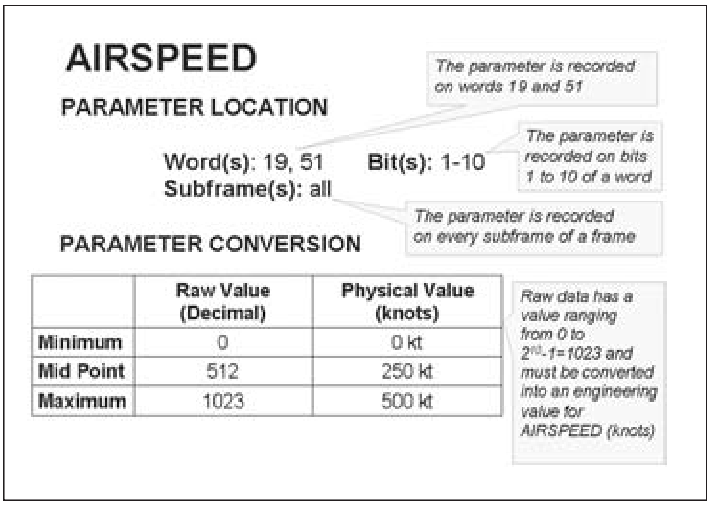


Figure 2. Information related to a parameter in the data frame layout document.

Parameter	Value range	Evolution	Bias	Corrective action
Computed airspeed	Consistent: values between 0 and 400 kt	Consistent: parameter cycles correspond to the history of flight between the dates xx/xx/xx and xx/xx/xx	0	None
Longitudinal acceleration	Consistent: values between -0,3 g and +0.3g	Consistent: positive when computed airspeed increases, negative when computed airspeed decreases	*+0.08*	*Adjust conversion to have this parameter zero-centered*

Table 1. Extract of an FDR inspection report.

quirements on recording quality. When these requirements are not met, various types of actions can be taken: replacement or repair of malfunctioning elements or modification of the data frame layout document. Two complementary maintenance tasks are presented below that would allow an operator to guarantee the continuous serviceability of installed FDRs and regulatory requirements pertaining to these tasks. References to non-mandatory guidance are also provided.

The first task is the FDR recording inspection. It starts with processing the entire FDR recording with decoding software that has been programmed according to the data frame layout document. Decoded parameters are then analyzed for quality. The operator should produce a report including the detailed results of the recording inspection and take corrective actions. Table 1 illustrates an extract of the recording inspection report.

A comprehensive inspection has at least four components—

- To check consistency of parameter values and evolutions with operational knowledge.
- To check the consistency of the parameters' patterns in typical phases of flight such as the causal relation between a flight control and associated flight surfaces in the context of takeoff.
- To check that the total accumulated time of unreadable data is limited and that there are no cyclical areas of unreadable data.
- To check that data were recorded in proper chronological order and without any overlapping.

ICAO Annex 6 Part I states that operators should carry out annual inspections of FDR recordings. It recommends that "the FDR data from a complete flight … be examined in engineering units to evaluate the validity of all recorded parameters." A report of this inspection should be made available to the state's regulatory authority. In addition, the recorder should be considered unserviceable "if one or more of the mandatory parameters is not recorded correctly." In contrast, neither JAR OPS 1 nor FAR Part 125 recommends any type of FDR recording inspection. However JAR OPS 1 requires a flight data monitoring (FDM) program for those aeroplanes with a maximum certificated takeoff weight in excess of 27,000 kg, as recommended by ICAO Annex 6 Part I. (The French transposition of JAR OPS 1 is more stringent, since it requires flight data monitoring for turbine-engine-powered aircraft with a maximum certificated takeoff weight in excess of 10,000 kg or with a number of seats in excess of 20.)

Numerous problems can be detected when FDM is put in place, even if this is not equivalent to a regular inspection of FDR recordings. Indeed, FDM sources are generally non-protected recorders, whose recording media can be removed and replaced quickly. Problems related to the FDR may, therefore, go undetected.

The second task is the calibration check of the FDR measuring channels. Indeed, conversion functions provided by manufacturers are the result of tests performed on prototypes and can, therefore, differ from the functions appropriate for a given aircraft. Several factors can alter the quality of the measurements, e.g., sensor aging and disassembly of mechanical elements during an overhaul, causing a sensor to go out of adjustment. These problems can go undetected since sensors used for recorders are sometimes different from the ones feeding data to flight instruments and other aircraft systems. In addition, parameters that are used to warn of unusual situations, such as GPWS warnings, are not activated during normal flights and do not appear on FDR recordings. For these reasons, a specific test is needed.

For a given parameter, this test consists of generating a series of baseline values and entering these values into a sensor (see Figure 3). The corresponding output values of the data acquisition unit are processed by a compatible readout system that computes the physical values using conversion functions of the data frame layout document. Deviations between input and readout system output are entered in a so-called "calibration table" and compared with the required accuracy, as shown in Table 2. The operator should produce a report containing parameter calibration tables and take corrective actions.

ICAO Annex 6 Part I indicates that such a calibration check should be performed at least every 5 years for the mandatory parameters and more frequently for those parameters provided by sensors dedicated to the FDR. The documentation related to calibration should be kept up-to-date accordingly. In contrast, neither JAR OPS 1 nor FAR Part 125 recommends a calibration check of the FDR measuring channels.

Apart from regulatory requirements, non-mandatory guidance on FDR operational checks has been issued by national authorities. For example, the FAA's Advisory Circular AC 20-141 provides guidance about maintenance operations on FDRs. It recommends that the operator maintenance program include an FDR recording check to determine "the reasonableness of mandatory parameters recorded by the DFDR" and a functional check "to verify the performance of any mandatory parameters not verified from the flight data." Guidance on FDRs has also been issued by non-state organizations such as EUROCAE. EUROCAE Document 112 contains recommendations and means of conformity for FDR maintenance.

Problems related to FDR readout and analysis

With about 30 FDRs read out and analyzed each year, half of them in the context of technical assistance to foreign investigation bodies, the BEA Engineering Department has broad experience of the readout problems that can be encountered.

Actual position measured with a clinometer (degrees)	**Raw output** value from the acquisition unit	**Converted value** using conversion functions (degrees)	**Deviation** (degrees)
+ 25.5 (right stop)	2,880	+ 25.2	- 0.3
0	2,065	0.5	+ 0.5
- 25 (left stop)	1,246	- 22.3	+ *2.7*
Maximum allowable deviation: +/- 2°			***Corrective action: adjust sensor setting***

Table 2. Example of a calibration check for a flight surface.

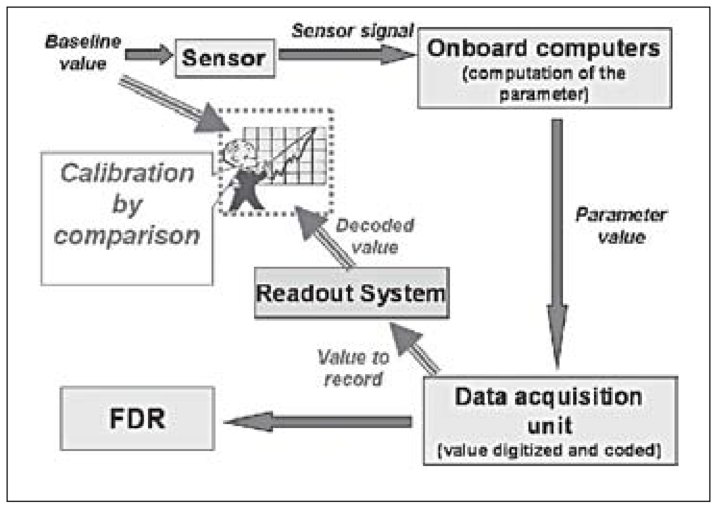


Figure 3. System calibration involves comparing baseline values with data-acquisition unit output values.

These problems generally occur due to airlines failing to adequately ensure the operational serviceability of FDRs. For this reason, the problems were categorized and grouped with the results of a survey conducted by the BEA in 2002 and 2003 on a representative sample of 20 French airlines. The survey was aimed at analyzing areas related to FDR maintenance and the use of FDR data, including the readout equipment used, the update of data frame layout documents, and FDM implementation.

The first category of problems pertains to missing or incomplete data. In many recordings, several parameters are found to be invalid and unusable—they have values that are not physically possible, or are very noisy (see Figure 4). Sometimes, large or cyclical periods of invalid data are found in a recording. In some recordings, flights overlap with each other, upsetting data chronological order. There are multiple causes for these problems, such as defective sensors, a connection or programming problem, or a defective recording medium. However, the main reason for the frequency of failures is the absence of adequate FDR recording inspection by operators.

As explained above, FDM is not strictly equivalent to FDR recording inspection, but it helps the operator to detect problems in the recording and is required by European regulations. The BEA survey revealed that only 9 out of 20 operators performed systematic FDM. These were mainly large airlines (more than 500 employees). Eight operators were found to perform regular but not systematic FDM, i.e., they limited data monitoring to a part of the fleet or to specific categories of events.

The second category of problems pertains to the operator retaining a copy of the generic documentation provided by the aircraft manufacturer instead of an up-to-date data frame layout document. This is often

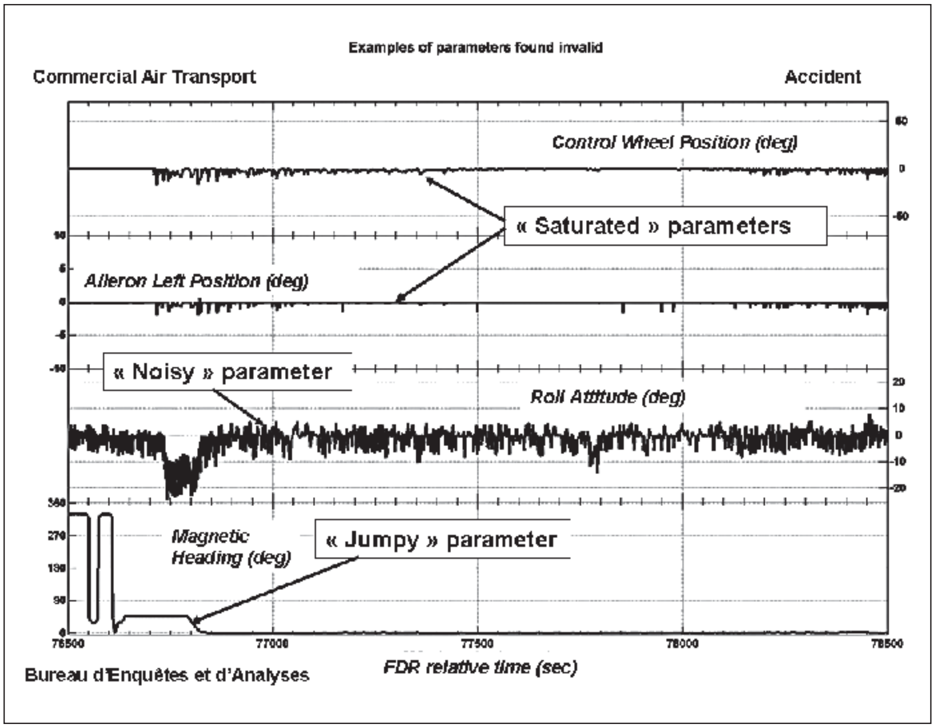


Figure 4. **Various problems may affect parameters from the same aircraft.**

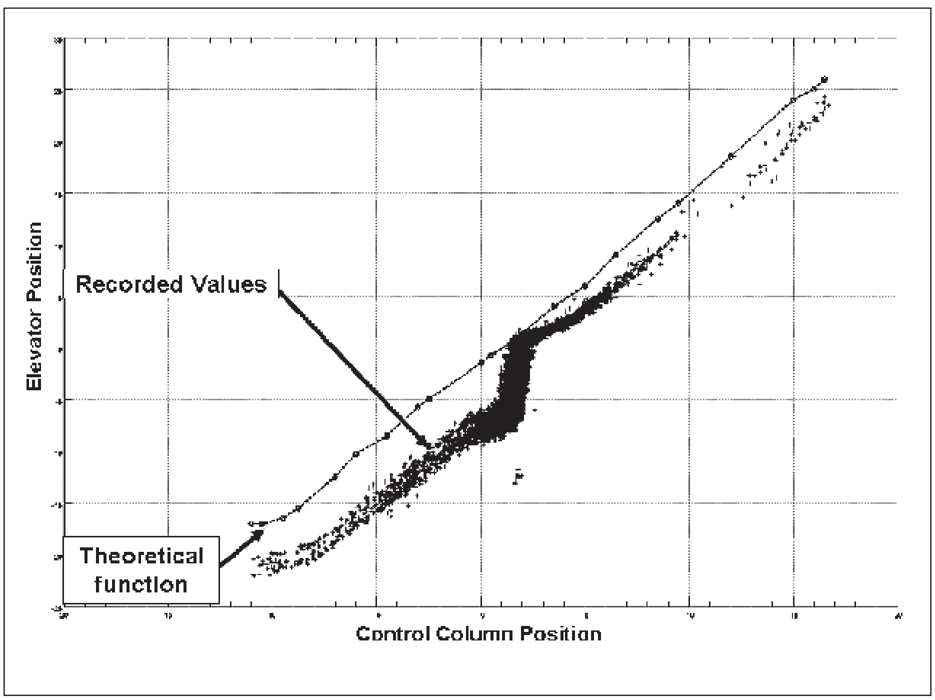


Figure 5. **Example of deviation from theoretical equation.**

associated with corrupt data in the FDR recording, since the operator does not have the document needed to perform an adequate recording inspection.

Retrofit of a FDR installation without modification of the data frame layout document is one identified cause: new parameters may not be documented or a parameter location may have been changed. Information related to FDR installation is also lost throughout the lifetime of the aircraft at each change of operator. The BEA survey revealed that only 11 out of 20 operators had complete data frame layout documents. These included operators performing FDM, as parameter analysis is not possible when data frame layout information is missing. Four operators had either incomplete or outdated documents; five operators did not store any documents.

The third category of problems pertains to absent calibration check reports. Generally the operator does retain generic parameter conversion equations but no parameter calibration tables. However, the difference between the decoded value and the actual value of a parameter happens to be higher than the required accuracy, as illustrated by Figure 5. Unchecked parameters may then lead investigators to erroneous conclusions, or excursions of a parameter beyond operational safe limits may go unnoticed by the operator FDM.

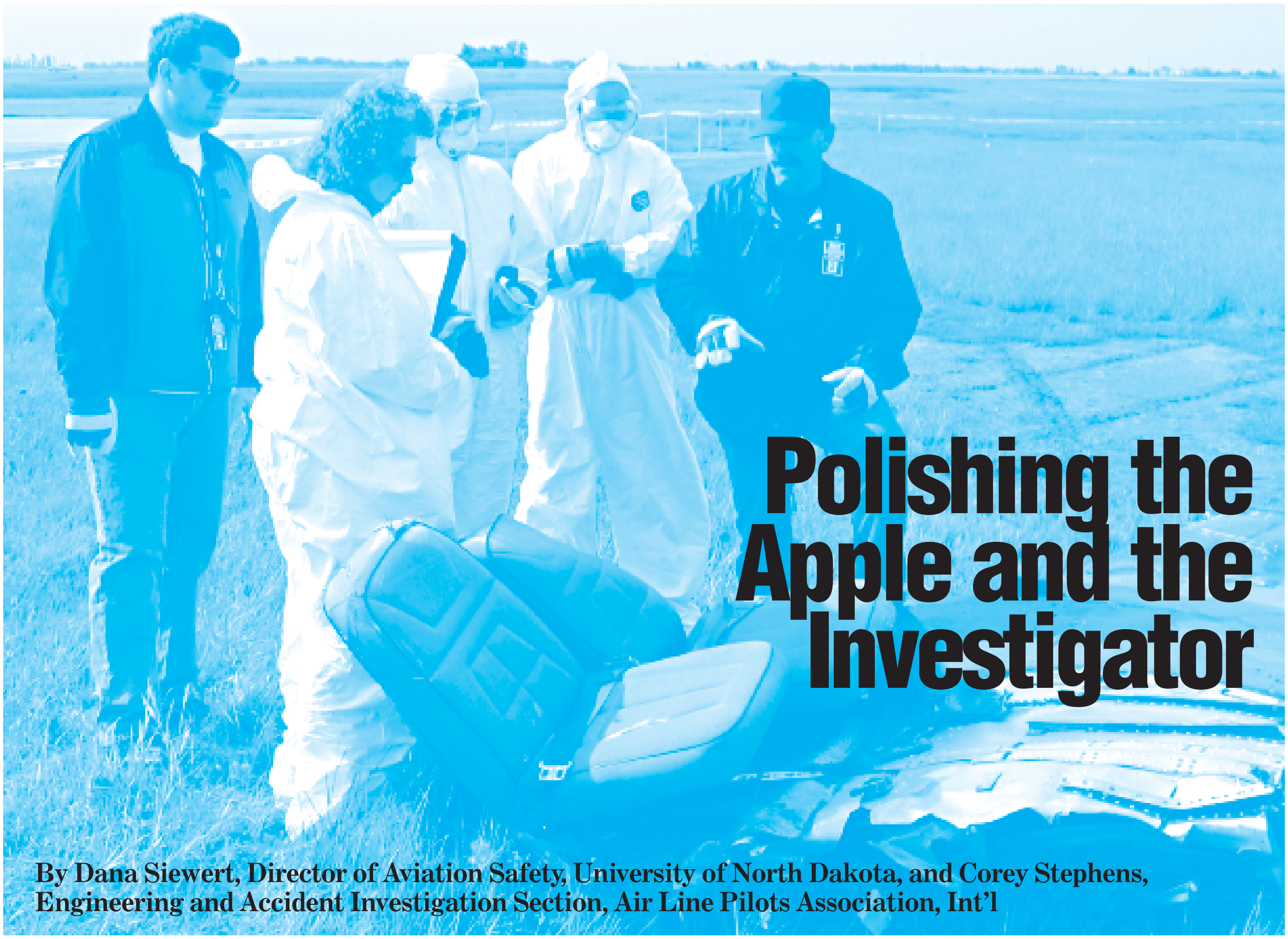
BEA's survey showed that no operators were performing any kind of calibration check of FDR measuring channels, which is no surprise since European regulations do not require this as a basic maintenance task. The operators checked elements of the measuring channels separately but did not test any measuring channels overall.

Progress and challenges

The BEA concluded that recurrent FDR readout problems are due to factors including data frame layout documents not being archived or properly updated, inadequate inspection of FDR recording, and absence of calibration checks of FDR measuring channels. These issues are often linked to poor specific knowledge about FDRs, especially among small- and mid-sized operators. In addition, national regulations trail behind ICAO-recommended practices and fail to give detailed and constraining requirements on FDR operational checks, even though valuable guidance already exists. Consequently, the BEA study dedicated to FDR maintenance contained several recommendations.

To improve the quality of data frame layout documents on a worldwide scale, the BEA recommended that the ICAO ensure, through its audit procedures, "that contracting states ensure that their operators can rapidly provide comprehensive and up-to-date data frame layout documents."

At the European level, the BEA recom-
(continued on page 29)



Polishing the Apple and the Investigator

By Dana Siewert, Director of Aviation Safety, University of North Dakota, and Corey Stephens, Engineering and Accident Investigation Section, Air Line Pilots Association, Int'l

"I hear and I forget. I see and I remember. I do and I understand."

***—Confucius* (551 BC-479 BC)**
Chinese philosopher and reformer

(This article was adapted, with permission, from the authors' presentation entitled Polishing the Apple and the Investigator—Examining the Importance of Investigator Education Prior to an Investigation, *presented at the ISASI 2006 seminar held in Cancun, Mexico, Sept. 14-17, 2006, which carried the theme "Incidents to Accidents: Breaking the Chain." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

In an ideal world, we wouldn't have aircraft accidents or incidents; but, if one were to occur, everyone would show up completely prepared and properly trained. While most investigative agencies are able to keep their investigators trained and "current," it can be difficult for other parties that support an investigation to keep up that same level of training. Parties in the United States bring technical expertise to an investigation. The pilots' association brings someone who is type rated and current in the aircraft as well as being familiar with company policy and procedures. The manufacturer is the expert on design, systems, and performance. The airline brings knowledge of company maintenance practices, policies, procedures, and training. The list goes on for every party member. All of the parties bring important knowledge to the process, and the investigation is more complete with this input. While it is important to have a knowledgeable person as a representative, it is also important to have that person prepared to participate in an investigation.

Experience shows there are four facts that can affect an investigator.

- **Training can become "stale" if not**

practiced regularly: Most investigative agencies have a core group of investigators who are trained and have built up experience working in the field. Unlike the investigative agency, parties that support an investigation normally don't participate in every investigation. Low accident rates over the last few years have kept most organizations "out of the field." Recently, most parties that support an investigation do much of their work by phone or e-mail, working smaller events that normally involve no fatalities. While the low accident rate is wonderful, it doesn't allow investigators to build up or maintain field experience. In busier years in the past, it was not uncommon for an investigator to complete initial training and work at least one accident or serious incident in the field. Some years, some carriers were a little busier and investigators could participate in two or three investigations. With improvements in safety and initiatives such as the Commercial Aviation Safety Team (CAST), air carrier accidents in North America are very infrequent. Without practice or regular review, an investigator's skills may become stale.

• **The field phase of an investigation can be overwhelming:** After an accident, an investigator is expected to "hit the ground running." If the wreckage is accessible, it is not uncommon to begin field work the day of or the day after an accident. For someone who works accidents regularly, there are a lot of familiar names and faces. For someone new, it can be daunting. You may have a long day in the field, having to work effectively and efficiently with a group that you first met at breakfast. The investigators also find themselves working in a totally alien environment. Wreckage, fire, spilt fuel, firefighters, law enforcement, and the press all add to the sights and sounds and can be distractions. For pilots working in the field, seeing an aircraft they have flown for some time and have learned to rely on, bent and broken in a field, can be disturbing. Indeed, pilots, flight attendants, mechanics, or other airline employees may find themselves looking at an aircraft whose history they may know and have possibly flown several times. All of these thoughts can cause someone unfamiliar with an accident site to feel overwhelmed. While the person is still a valuable resource, he or she may not be as focused as need be.

• **The party and investigative group system can be confusing:** While the investigator-in-charge (IIC) has the ultimate control on any site, the average participant will interface more with the investigative group chairman and the party coordinator. We have found that you can present the chain-of-command structure to new investigators in a classroom setting; but until they see the structure in place and at work, it doesn't really become clear to them. An investigator working an accident for the first time can easily be caught in procedural mistakes that lead to not only lost time but possibly lost evidence. It can take a couple of days for a new investigator to fully understand the information flow pattern from the investigative groups up to the IIC and then back out to the parties. If an investigator has a better grasp of the process and information flow earlier in the investigation, the more beneficial that investigator will be to his or her group and party.

• **Being a subject expert does not ensure success in the field:** A person can be a renowned expert in a particular area but lack the basic skills needed to be a successful investigative group member. An investigator must be ready to not only lend expertise, but also be able to function in the field. If the investigative group will be working on a crash site, then the group needs to have been trained in how to dress for the environment and the safety protocols to be used on site. No matter which group the investigators will be working with, they owe it to the investigative agency, the group they will be participating on, and to their party to know what that group's purpose is and what is expected for a final product.

Limiting examples

In cases where investigators have limited experience in the field, it can take some time for them to become acclimated. While working the wreckage of a CFIT accident several years ago, an investigative group was documenting impact marks in a wooded area. All group members but one were dressed appropriately. This member would have been highly valuable to the group, but he was forced to stand on the sidelines because he was not prepared to work in the

Dana Siewert, director of Aviation Safety for UND Aerospace, has more than 9,000 flight hours and holds an airline transport pilot certificate in both single- and multi-engine aircraft with commercial privileges in single-engine sea and helicopter. He is s also a designated FAA pilot examiner for private through airline transport pilot and flight instructor certificates and associated ratings and an FAA-appointed accident prevention counselor. He was awarded the University Aviation Association John K. Lauber Award in 2005 for outstanding achievements in collegiate aviation safety.

Corey Stephens, a senior member of ALPA's Engineering and Air Safety Department, participates in all of ALPA's accident investigation activity, and he is the staff lead for ALPA's Advanced Accident Investigation Course. Corey is the industry co-chair of the CAST/ICAO Common Taxonomy Team (CICTT) and also serves as an ALPA representative to the Commercial Aviation Safety Team–Joint Implementation Monitoring Data Analysis Team (CAST–JIMDAT). Corey has also worked in the Safety Department of United Airlines and with the National Transportation Safety Board.

Because the field phase of an aircraft accident investigation can be confusing, chaotic, and labor intensive, this hands-on course using an actual aircraft wreckage and a re-created aircraft accident site provides participants opportunities they could never experience in a classroom, learn from reading a book, or experience watching a video or DVD.

environment. He had been chosen because he was a subject matter expert, but he had never received any training outside a classroom and had no field experience. This accident taught him some valuable lessons for the future.

In another example from a different accident, a group member was accompanying his group to document switch positions in a cockpit. This member had limited accident investigation experience but was assigned to this event because of previous experience as a pilot and in airline operations. While the group was preparing to enter the cockpit, this member began randomly flipping switches. The member was confronted and quickly admitted he didn't realize he had done anything wrong. It was unclear if he correctly recalled all the switches he had flipped. This investigator had limited field experience and had no clue as to the importance of protecting evidence.

These examples clearly show that the need for some initial training in a field environment is necessary. The stakes of any aircraft investigation are extremely high. Not only are there lessons to be learned, but the potential outcome can have a dramatic effect on companies, careers, and organizations for many, many years. Because of this, the quality of an investigation is of the utmost importance. In order to keep the quality of an investigation high, the investigators must be properly trained, well prepared, and focused.

Combined training

While there are countless books, brochures, and pamphlets on aircraft accident investigation techniques, printed words alone cannot fully impart issues encountered in the field. There are many organizations and educational institutions that provide classroom courses and theory on the subject, but provide little practical hands-on, "tin-kicking" application. The ability to maintain pace with changing technology, commercial and general aviation glass cockpits, technically advanced aircraft (TAA), and very light jets (VLJs) is, and will continue to be, a current and expanding challenge for future accident investigators.

In addition to the National Transportation Safety Board, or any country's investigative agency, there are a multitude of "parties" that have expertise as well as an interest in the findings that result from an investigation. From air carriers to aircraft manufacturers, law enforcement, flight schools, and flight departments, all facets of aviation at some point in time may be called upon or may need to participate in the investigative process.

Unfortunately, many of those that may become, or have a willingness to become, a party to the investigation have limited guidance and low experience levels as investigators. Past experience shows that the efficiency of those investigating a major airline, general aviation, or military aircraft accident depends on each investigator's knowledge of the investigative process and techniques, how this "process" works, and the politics that may become apparent with a variety of federal and local agencies as well as personalities.

Figure 1

One method of preparing investigators for field investigations is through a realistic training program. An ideal program will bring together all of the facets of an investigation, from wreckage and environment to the investigative process and parties. This combined training program would expose investigators to all of the sights, sounds, personalities, and confusion of an accident—but without the criticality and pressures faced at an actual site. The skills learned in this type of course would not only be of benefit for an accident investigation, but also for incident investigation. Both types of investigation involve some of the same personnel and procedural problems.

Recently, two organizations known internationally for their reputations in advancing aviation safety and education entered into a joint venture by pooling their resources and expertise to achieve a particular goal that would have been difficult, if not impossible, to accomplish individually. The Air Line Pilots Association, Int'l (ALPA) and the John D. Odegard School of Aerospace Science located at the University of North Dakota (UND), in a cooperative effort, have joined forces to provide a stage that allows industry and education to come together, forming an educational team that focuses specifically on training the aircraft accident investigators of the future.

While not designed to solve aircraft accidents, the realistic course places participants in the logistics involved in accident response, participation, on-scene investigative groups, and investigative techniques. This cooperative effort by ALPA and UND has resulted in a lifelike, hands-on experience that provides participants an educational course on intricacies of aircraft accident investigation. (See Figure 1 and 2.)

Because the field phase of an aircraft accident investigation can be confusing, chaotic, and labor intensive, this hands-on course using an actual aircraft wreckage and a re-created aircraft accident site provides participants opportunities they could never experience in a classroom, learn from reading a book, or experience watching a video or DVD. From site safety to site survey, the course's on-site examination demonstrates many of the activities and issues encountered in the field. Additionally, the course simulates a "contaminated" wreckage site, which trains applicants on the use

(continued on page 30)

NTSB Chief Addresses MARC Meeting

"Good evening fellow safety professionals" is how the chairman of the National Transportation Safety Board opened his remarks to the more than 80 attendees and guests of the ISASI Mid-Atlantic Regional Chapter's annual spring meeting held in Herndon, Va., just outside of Washington, D.C., on May 3. Chairman Mark V. Rosenker spoke about how his agency improves safety through its transparent, objective, and comprehensive approach to accident investigation.

In opening remarks, he said, "Before we conclude this evening, I'd like to hear about your concerns. This is an excellent opportunity for me to receive feedback from your technical expertise." He explained that questions would be taken and then entertained the group with quips about how he came to hold the chairmanship of the premier safety agency. But turning serious, he said, "This is the best job in federal government. You can make a difference, like YOU can make a difference in aviation, in marine safety, in rail safety, pipeline safety, and in highway safety. But, today I want to talk to you about aviation safety, and I believe we are kind of like partners in that area, good partners, productive partners—a partnership that works and works extremely well."

Turning to his prepared remarks, he noted that all documents and records that become part of an NTSB investigation are available to the public. "We believe open access to information provides full transparency and a more complete understanding of the investigation process," Rosenker said. "In this manner, we maintain the credibility of the investigation and make a significant contribution to aviation safety in every corner of the world."

Rosenker reminded the group that the Safety Board approaches every accident with a rigorous commitment to objectivity. Referring to the October 2006 accident in which baseball player Cory Lidle's airplane crashed into a high-rise apartment building in Manhattan, Rosenker said, "We didn't let the high-profile nature of the accident obscure the facts." On May 1, the NTSB determined that the probable cause of that accident was "the pilot's inadequate planning, judgment, and airmanship in the performance of a 180-degree-turn maneuver inside of a limited turning space."

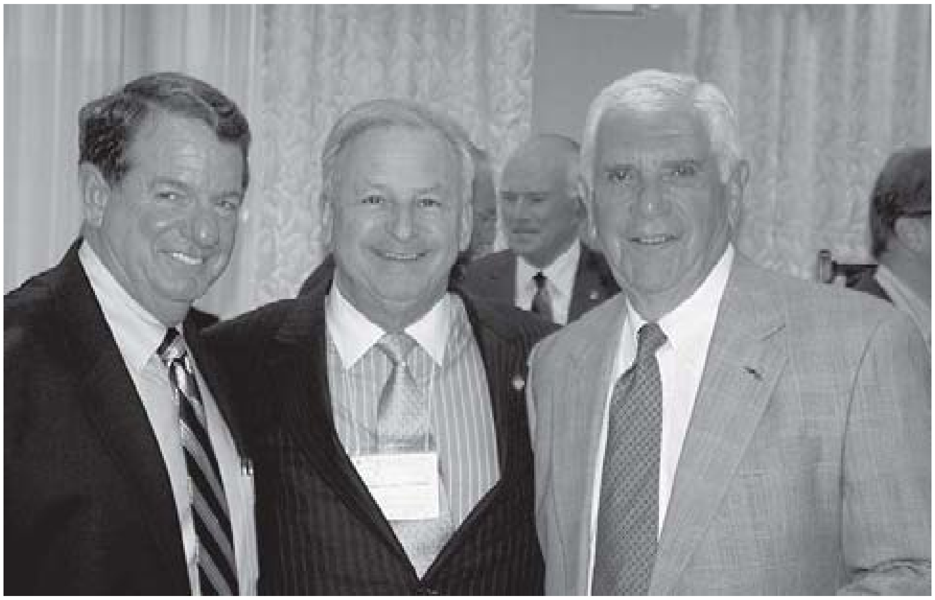
In addressing the NTSB's comprehensive approach, Rosenker cited the ongoing investigation of the Comair accident in Lexington, Ky., in August 2006, in which 49 people were killed. "We are examining all possible areas including airport markings, construction issues, the notice to airman system, air traffic control procedures, crew resource management, personnel fatigue, and new technologies in the cockpit." The investigation is expected to take about a year to complete, with the Board meeting scheduled to take place July 26, 2007.

Chairman Rosenker also reiterated the Board's view that aircraft in the taxiing and landing phases of operations, at airports of all sizes, are still at a much-too-high risk of collision. "The current aircraft movement system, or AMASS, is not sufficient," said Rosenker. "We need ground movement safety systems that will prevent runway incursions at both large and small airports." The call for a new system to prevent runway incursions and ground collisions has been on the NTSB list of "Most Wanted" safety improvements since 1990.

During a robust question-and-answer period, attendees asked a variety of them. For example: Why did the NTSB drop the child restraint issue from the "hot list"? How will the Board answer the need for the public to have more prompt information about the cause of an accident? Can the Internet help? Do you see an increase in the NTSB funding level for next year? What is the Board's position on cockpit video recorders, their implementation, and their protection? The chairman

E. MARTINEZ

ABOVE: Ron Schleede prepares to introduce guest speaker Rosenker. LEFT: NTSB Chairman Mark V. Rosenker.



PHOTOS: E. MARTINEZ

Enjoying the MARC reception are, left to right, Frank Del Gandio, Chairman Mark Rosenker, and Bill Hendricks.

answered all with a frankness appreciated by the audience.

In other MARC activities of the evening, following a buffet dinner of seafood, poultry, and tasty deserts, President Ron Schleede welcomed the many international guests to the regional meeting and reminded all that the ISASI International Council, whose members were in attendance, was conducting its spring meeting the next day. He introduced ISASI President Frank Del Gandio, who in turn made a short report on the success of the Society's Reachout Program: 1,154 persons have attended 19 workshops; introduced international guests; and welcomed three new Chapter members: Candace K. Kolander, Association of Flight Attendants; Peter D. Devaris, FAA, Safety Analysis Branch manager, supervisory analyst; and Bruce G. Flinn, MaxJet, director of safety.

Ron then announced that an invitation to all had been extended by nearby Dulles International Airport to observe its Triennial Airport Emergency Plan Exercise taking place the next day. He then turned to the ISASI memorial scholarship fund, which MARC, in concert with the family of Rudy Kapustin, helped initiate (see page 3). A message from Noelle Brundlle, 2003 scholarship awardee, said: "The turning point for me on my journey in this career was winning the scholarship and attending the ISASI 2003 seminar. I met many great people who took time to both share their experiences with me and encourage me when I needed it." She now is employed in the aviation safety business.

For the second year, the MARC meeting became a platform from which to seek support for the memorial fund. This year, 22 individuals and organizations answered Ron's podium call for donations. The final tally was $4,100. Those contributing included the Canadian Society of Air Safety Investigators/Barbara Dunn; the Dallas/Fort Worth Chapter/Curt Lewis; European Society of Air Safety Investigators/David King/Anne Evans; the Irish Aviation Authority/Kevin Humphreys; Mid-Atlantic Regional Chapter/Ron Schleede; Reynolds Technologies Int'l/Joe Reynolds; Southwest Airlines Pilots Association/John Gadzinski; Kreindler & Kreindler/ Christine Negroni; My Father's Vineyard, Inc./Joseph V. Montone; John Goetz-

Ann Schull, ISASI office manager, signs in attendees.

In Memoriam

Capt. Ernest R. Burmeister (MO0211), Glen Elyn, Ill., USA

Richard J. Sample (MO2827), Ormond Beach, Fla., USA

Kelly L. Teague (MO4967) Mustang, Okla., USA ◆

Jones Day; Hall & Associates LLC/Jim Hall; Frank Del Gandio; William B. Hendricks; Michael Hynes; Chris Baum; Dennis Jones; Joann Matley; Mike Pangia; John Purvis; the Honorable Mark V. Rosenker; Ron Schleede; and Richard Stone.

In addition, door prizes were provided by AirTran Airways, Honeywell, Airbus, Boeing, Crowne Plaza Hotel; ALPA, and ISASI. ◆

ISASI 2007 Awaits Delegates Arrival

Final scheduling and programming is near completion for ISASI 2007, and the next expectation is the arrival of the 300-plus delegates and guests expected to attend ISASI's annual safety seminar being held in Singapore from Monday, August 27 to Thursday, August 30.

The seminar will be hosted by the Air Accident Investigation Bureau of Singapore (AAIB) and will be opened by the Singapore minister for transport. The seminar's theme is "International Cooperation: From Investigation Site to ICAO." Guest speakers include. Mark Rosenker, the chairman of the United States National Transportation Safety Board.

Chan Wing Keong, seminar chairman, says that 27 technical papers have been selected for publication in the seminar *Proceedings* and 20 of them would be scheduled for presentation during the 3-day technical session. Topics to be addressed are international accident investigations, investigation techniques, air traffic control, human factors, flight recorder, accident prevention, and communications. Members of the technical papers selection committee include Chan Wing Keong (AAIB Singapore, chair), Michael Toft (AAIB Singapore), Caj Frostell, Jim Stewart, Keith McGuire, Ken Smart, Capt. Mohammed Aziz, Dr. Rob Lee and Y P Tsang (Hong Kong, CAD).

Seminar registration is ongoing. The fee (in U.S. dollars) by July 31 is as follows: member $480; student member $200; non-member $525. If registration is made after July 31, the fees are $525, $225, and $570, respectively. Day pass fee for any of the three days is $190 by July 31 and $230 after that date. The member fee for either of the two tutorials set for August 27 is $100 by July 31 and $120 after that date; student member $70 and $90; and non-member $100 and $120. Companion fee is $295 by July 31 and $330 after that date. The fee for the day-long post-seminar function conducted on August 31 is $100.

AAIB has established a detailed and easy-to-manage website at www.isasi07.org. All areas of interest are easily accessed on the site. For example, in its subject menu under "Travel Info," one is taken to "Visa Requirements" (travelers from some 21 countries require a visa to enter Singapore), entry requirements, exist requirements, and traveler tips. All seminar program topics are listed, as is information about Singapore.

Swissôtel The Stamford, Singapore is the seminar hotel. The AAIB Singapore has secured deluxe rooms at a nominal room rate of $230.00 (Singapore dollars), subject to taxes. Delegates must contact Swissôtel The Stamford directly regarding their accommodation arrangements. The hotel registration form is available on the seminar website (www.isasi07.org). Also, seminar and hotel registration forms were reprinted in the April/June issue of *ISASI Forum* for your use.

Social programming has been completed and includes on Monday evening a welcome reception; Tuesday, companion city tour to Supreme Court, Parliament House, Central Business District, Victoria Theatre & Concert Hall, St. Andrew's Cathedral, Merlion Park, the Esplanade Theatres on the Bay, Bumboat ride, the Asian Civilization Museum, Royal Selangor Pewter Center, Chinatown Heritage Center, the Buddha Tooth Relic Temple and Museum, and a rickshaw ride. Tuesday evening delegates and companions will enjoy an off-site dinner at the Night Safari. On Wednesday companions will visit the botanic garden, national orchid garden, Fort Canning Park, Spice Garden, "Battle Box" at Fort Canning Hill, Kampong Glam Village, Sultan Mosque, Arab Street, and Little India. The evening is a "free and easy" night. Thursday day is slated as "free and easy." That evening the group will celebrate the seminar's Awards Banquet.

The post-seminar optional tour on Friday will start with a visit to Jurong Bird Park, include lunch, and end with a tour of Sentosa Island, including Butterfly Park, Merlion Tower, Images of Singapore, Fort Siloso, Underwater World, and Siloso Beach. Those delegates not departing Singapore that evening will enjoy a leisurely cable car ride to the hill top of Mount Faber for dinner at the famous Jewel Box with its panoramic sunset view of the world's busiest harbor and Singapore city. ◆

Ron Chippindale Receives New Zealand Service Medal

Ron Chippindale, ISASI councillor for New Zealand and the 2004 Jerry Lederer Award recipient, was presented the New Zealand Special Service Medal (Erebus) for his investigation work as

Police Commissioner Howard Broad (left) congratulates Ron Chippindale as Police Minister King looks on.

investigator-in-charge of the crash involving Air New Zealand flight TE 901 (DC-10) near Mt. Erebus, Ross Island, Antarctica, on Nov. 28, 1979, with the loss of all 257 on board.

This initial presentation of the New Zealand Special Service Medal involved 22 persons who participated in crash response activities, Operation Overdue. Police Minister Annette King said in presenting the Medal that it was instituted by the government in 2002 to "recognize service or work for New Zealand in very difficult, adverse, extreme, or hazardous circumstances that fall outside the boundaries of what individuals could normally expect as part of their routine duties or work."

Prime Minister Helen Clark said when announcing the creation of the medal, "The work of personnel involved at Mt. Erebus far exceeded the boundaries of what could be expected in the course of normal police, search and rescue, or air accident investigation duties. The circumstances were extreme: a hazardous physical location, extreme climatic conditions, dangers presented by the wreckage, the psychological strain of recovering the victims, and highly demanding physical work."

Ron informs the *Forum* that other ISASI members involved in the crash response include Peter Rhodes, David Graham, and Steve Lund who each assisted with the investigation at the accident site in Antarctica. U.S.-based individuals are expected to receive their awards at a later date. ◆

ATS Working Group Maintains Commitment

During ISASI 2006, the ATS Working Group made a public commitment to ensure the construction, preparation, and delivery of an ATS-specific paper for each future ISASI conference. It met that pledge for 2007 when its paper was accepted for presentation by the Singapore organizing committee.

The paper titled "Tenerife to Today—What Have We Done in Thirty Years to Prevent Recurrence?" will be presented by ATSWG Chairman John Guselli and Vice-Chairman Ladislav Mika. It will focus on progress made in runway safety since 1977, as seen through the eyes of the safety stakeholders with the "birds eye" view.

Significant contributions from the Working Group membership have enabled the status of contemporary runway safety to be reviewed with particular emphasis on the European, North American, and Asia Pacific regions. ◆

Reachout Workshops Reach 1,187 Persons

The ISASI Reachout Workshop Program has "graduated" 1,187 persons during its 20 completed workshops since its inception in 2001. The program's first session was held in Prague, Czech Republic and its 20th in Dubai, United Arab Emirates, and the next is to be held in Santiago, Chile. In all, 18 states/countries have been venues for the Workshops.

Jim Stewart, chairman of the ISASI Reachout Committee, has announced that a Reachout Workshop will be held in Santiago, Chile, from October 29 to November 2. With strong support from ISASI member Claudio Pandolfi, the Workshop will include sessions on accident investigation and Safety Management Systems (SMSs). The Workshop is being primarily supported by the Chilean pilots association and the DGAC of Chile. Other corporate sponsors for the event will provide air travel to and from North America.

Preliminary plans for Reachout Santiago were made during the ISASI seminar in Cancun last year, and Stewart credits efforts made by Pandolfi in securing arrangements with local sponsors to ensure the successful delivery of the Workshop, which is being fully supported by ICAO. Also involved in the discussions to bring Reachout to South

New Members

CORPORATE

AAIU Ministry of Transport Bulgaria
Atanas Kostov
Yavor Petrov
Charles Taylor Aviation, Singapore
Robert J. McParlin
Andrew Cripps
Gulf Flight Safety Committee, Azaiba, Oman
Capt. Manin K. Al Said
Mike Litson
Jeppesen, Englewood, Colo., USA
Richard Fosnot
Sandra Stedman
Korea Aviation & Railway Accident Investigation Board
Sooncheol Byeon
Kyungin Yoo

INDIVIDUAL

Ahmed, Syed, Naseem, Karachi, Pakistan
AlBarwani, Nasser, Muscat, Oman
AlNaamani, Said N., Muharraqh, Kingdom of Bahrain
AlSubhi, Waheed K., Muharaoh, Kingdom of Bahrain
Al-Mousawi, Hassan, S. Doha, Qatar
Al-Said, Manin, K. Azaiba, Oman
Andrews, Gayle, Auckland, New Zealand
Ballard, Paul, W. Amaroo, ACT, Australia
Banovetz, Mark, T., Naperville, IL, USA
Bao, Hongyang, Glastonbury, CT, USA
Barrie, Phillip, G., Budaiya, Bahrain-Arabian Gulf
Bedard, Ronald, M., Vancouver, BC, Canada
Bradding, Tim, J., Christchurch, New Zealand
Chinarro, Jesús, A., Madrid, Spain
Chukwu, Michael, Zaria, Nigeria
Deragon, Hugo, St. Jean, Surrichelieu, QC, Canada
Devaris, Peter, D., Crofton, MD, USA
Dulmage, Molly, A., Prescott Valley, AZ, USA
Earl, Laurie, Lower Hutt, New Zealand
Eltham, Adam, W., J. Auckland, New Zealand
Eturki, Mohamed, M., Riyadh, Saudi Arabia
Evans, James, M.D., Christchurch, New Zealand
Flinn, Bruce, G., Herndon, VA, USA
Freeman, Julie, A., Forth Worth, TX, USA
Gardiner, Alaister, C., Marton, New Zealand
Glatt, Marcus, Herzogenrath, Germany
Haraldsson, Stefan, A., Kopavogur, Iceland
Heiduk, David, J., Saskatoon, Saskatchewan, Canada
Huling, Murray, D., FPOAP, USA
Jones, Christine, R., Inver Grove Height, MN, USA
Kibblewhite, Robert, K., Abu Dhabi, United Arab Emirates
King, Philip, G., Dubai, United Arab Emirates
Kolander, Candace, K., Alexandria, VA, USA
Liggett, Roy, B., Leesburg, VA, USA
Martin, Ruth, S., Farnborough, England
McKay, Sean, P., Sheffield, New Zealand
Medina, Carlos ,P., LaLa Guna, Spain
Migdal, Joshua, A., Woodland Hills, CA, USA
Montgomery, Warren, T., Dubai, United Arab Emirates
Moss, Douglas, M., Torrance, CA, USA
Motion, David, J., Dubai, United Arab Emirates
Nachia, Duleep, Doha, Qatar
Portier, Denis, A., Dubai, United Arab Emirates
Rebbapragada, Dharamraj, Doha, Qatar
Robertson, Philip, M., Albury, Australia
Robinson, Daniel, T., Moose, Jaw, SK, Canada
Robinson, Edwin, W., Annapolis, MD, USA
Shreni, Andrea, D., Hyattsville, MD, USA
Sikora, Ivan, Dubai, United Arab Emirates
Simmons, Gregorio, G., Port Orange, FL, USA
Turner, Glen, N., Bulls, New Zealand
Watson, Richard, A., San Antonio, TX, USA
Welch, Breanna, K., Ormond Beach, FL, USA
Wilson, Steven, D., Al Jasra, Kingdom of Bahrain ◆

Shown are the attendees and instructors of the Dubai Reachout Workshop.

America for the second time were ISASI members Horacio Larrosa from Argentina and Fabio Catani from Brazil.

ISASI Reachout No. 20, a 5-day workshop, was held in Dubai, United Arab Emirates, from February 25 to March 1. It was organized by the Gulf Flight Safety Committee (GFSC) and hosted by The Emirates Group, according to a report by Caj Frostell, Ron Schleede, and Mike Doiron, ISASI team instructors. The program covered accident investigation management and accident prevention, SMS, and human factors.

Sponsors for the Workshop included Emirates Airline, Qatar Airways, Abu Dhabi Aviation, Etihad Airlines, Air Arabia, the Boeing Company, AviateQ International, and ISASI.

Workshop participants totaled 33, representing the following organizations: Emirates Airline, GFSC, Qatar Airways, Gulf Air, Abu Dhabi Aviation, Air Arabia, H.M. Royal Flight of Oman, Royal Flight Bahrain, National Air Services (Saudi Arabia), Gulf Helicopters, Amiri Flight (Abu Dhabi), AeroGulf, Sharjah Airport, Dubai Air Wing, Oman Airports Management Company, and UAE Department of Civil Aviation. Sixteen of the attendees filed applications for ISASI membership, and GFSC became a corporate member, speaking well for the professional level of the program.

Brisbane, Australia, was the venue for Reachout No. 19 held in December 2006. Training was conducted by Lindsay Naylor, ISASI Australian councillor. He was also instrumental in organizing the event at the behest of ASASI members who sought some investigative-type training to their respective organizations.

The 4-day workshop included a variety of subjects including a legal overview of accident investigation, Annex 13 and the role of the accredited representative, witness interviewing, human factors, use of field equipment, photography, wreckage mapping, site survey, graphic reconstruction, and structural fundamentals. Participants were introduced to accident investigation history, forensic engineering, material failures, and dealing with the news media and next of kin. Case studies of accident investigation were included. Bloodborne pathogen training was also provided.

Fifty people participated in the Workshop from across many sectors of the Australian aviation industry (airlines, regulator, manufacturers, investigating authority, defense), from which the instructors were drawn. Lindsay reported that the informal investigative training seminar was remarkably successful, and this was largely due to the support received from several ISASI corporate members—ATSB, DSTO, DDAAFS, and Qantas.

Typical of the feedback received was this e-mail: "I very much enjoyed the course, and it has certainly benefited my professional development. It was great to meet so many inspiring aviation professionals, and the caliber of the speakers was exceptional! I would very much recommend the course to future participants and hope that it continues in the future." ◆

Peter Williams (right), New Zealand Society president, makes the traditional "opening bell" hand over for the next year's seminar to Lindsay Naylor, Australian Society councillor.

ANZSASI June Seminar Draws Large Attendance

More than 125 persons attended the 2007 regional air safety seminar hosted by the New Zealand Society in Wellington from June 8-10. The seminar was supported and sponsored by corporate members Air New Zealand and the RNZAF, and by the Civil Aviation Authority of New Zealand, Air Nelson, Vincent Aviation, Airclaims, and the Transport Accident Investigation Commission.

The New Zealand Minister for Transport Safety, the Hon. Harry Duynhoven, opened proceedings, followed by the CEO of TAIC, Lois Hutchinson, who explored the purpose of TAIC and gave her thoughts on future directions for the Commission. The Australian Defence Force safety team, also a corporate member, provided its usual solid support with a large turn out and some good papers. Air Vanuatu attended for the first time.

Papers with an airline flavor came from Boeing, Air New Zealand, and Air Nelson.

Jim Burin of the Flight Safety Foundation gave an encouraging account of progress in commercial airline safety, noting how improvements in technical and operating areas have come out of investigations. Investigators from the TSBC and ATSB gave informative presentations on some current major air accident investigations, and a CAANZ investigator had a well-illustrated example of the hazards present when investigating in an alpine environment.

Also, a paper on police disaster victim identification procedures was followed by an explanation by the chief coroner of New Zealand of that country's recently overhauled system. Some human performance issues were covered with a thoughtful paper on pilot workload and perceived safety of RNAV (GNSS) approach procedures, and an entertaining yet serious paper on safe communication in aviation. Other papers discussed the training of investigators, training of pilots, flight recorder analysis, and safety philosophy.

The opportunity was also taken to hold general meetings of the New Zealand and Australian Societies. During the seminar, more than 12 applications for ISASI membership were received, with more expected. The annual seminar has become an important event on the accident investigation and air safety calendar. Next year's seminar will be hosted by ASASI at Adelaide. ◆

Kapustin 2006 Scholar Takes SCSI Course

Leonardo Ferrero. one of the two 2006 recipients of the ISASI Rudy Kapustin Memorial Scholarship Fund, participated in the SCSI Aircraft Accident Prevention and Investigation Course April 16–27,

Leonardo (center) is shown with class instructors (left to right) Mika, Schleede, Frostell, and Dorion.

2006 Annual Seminar Proceedings Now Available

Active members in good standing and corporate members may acquire, on a no-fee basis, a copy of the *Proceedings of the 37th International Semina*r, held in Cancun, Mexico, Sept. 11-14, 2006, by downloading the information from the appropriate section of the ISASI website at http://www.isasi.org.

The seminar papers can be found in the "Members" section. Alternatively, active members may purchase the *Proceedings* on a CD-ROM for the nominal fee of $15, which covers postage and handling. Non-ISASI members may acquire the CD-ROM for a US$75 fee.

A limited number of paper copies of *Proceedings 2006* are available at a cost of US$150. Checks should accompany the request and be made payable to ISASI.

Mail to ISASI, 107 E. Holly Ave., Suite 11, Sterling, VA USA 20164-5405. ◆

Speakers and Technical Papers Presented at ISASI 2006

LATIN AMERICA DAY—*Tuesday, September 12*
Keynote Address Capt. Gilberto Lopez Meyer, DGCA Mexico
Remarks Stuart Matthews, President and CEO, FSF
Horacio Larrosa, JIAAC, Argentina—*Accident and Incident Investigation in Argentina—One View about a Maintenance Related Case*
Capt. Carlos Limon, ASPA Mexico—*A CFIT Accident: Lessons Learnt*
Claudio Pandolfi, Chile—*The Advanced Qualification Program (AQP) as a Tool to Break the Chain of Accidents*
Fabio Catani, **Sergio Rodrigues Pereira, and Umberto Irgang**, Embraer, Brazil—*Risk Analysis Methodology Application and Results for Product Safety Monitoring at Embraer*
Richard H. Wood, USA—*Defining and Investigating Incidents*

INTERNATIONAL DAY—*Wednesday, September 13*
Randall J. Mumaw, Boeing, USA—*Industry Working Group for Enhancing the Investigation of Human Performance Issues*
Dr. Joseph Rakow/Dr. Alfred M. Pettinger, Exponent Failure Analysis Associates, USA—*Failure Analysis of Composite Materials in Aircraft Structures*
Guillaume Aigoin/Guilhem Nicolas, BEA, France—*Solving FDR Readout Problems: A Proactive Approach*
Bert Ruitenberg, Tower & Approach Unit, Schiphol Airport, the Netherlands—*Using the Threat and Error Management (TEM) Framework as an Analytical Tool in ATC*
Michael Walker, ATSB, Australia—*The ATSB Approach to Improving the Quality of Investigation Analysis*
Dr. Kaare Halvorsen/Dr. Grete Myhre, AIB, Norway—*An Investigation as to How Aviation Safety Will Be Maintained in the Light of the Major Change Processes Taking Place in the Norwegian Civil Aviation Sector*
Johann Reuss, BFU, Germany—*Incident Investigation: A Diversion of a Boeing B-747 Resulting in a Serious Low-Fuel Situation*
Wen-Chin Li/Don Harris, Cranfield University, UK—*Breaking the Chain: An Empirical Analysis of Accident Casual Factors by Human Factors Analysis and Classification System (HFACS)*

INVESTIGATOR'S DAY—*Thursday, September 14*
Nick Stoss, Transportation Safety Board of Canada—*Major Investigation Management*
William R. Kemp, TSBC, Canada— *A Safety Issue Investigation into Small Aircraft Accidents Resulting in Post-Impact Fire: The Experience, Techniques, and Lessons Learned*
Gary R. Morphew, SCSI, USA—*Investigation into Turbulence-Related Accidents*
Dana Siewert, UND, USA/**Corey Stephens,** ALPA USA—*Polishing the Apple and the Investigator—Examining the Importance of Investigator Education Prior to an Investigation*
Stéphane Corcos/Alain Agnesetti, BEA, France—*Investigating a 'Minor' Incident Using Lessons Learned from a Major Accident*
Sue Burdekin, University of New South Wales, Australian Defense Force Academy—*Listening to the Specialists: How Pilot Self-Reporting Can Help Break the Accident Chain*

2007, in Prague in the Czech Republic. The course was held in the facilities of the Czech Airlines (CSA) Crew Training Center at the airport in Prague.

As part of the 2006 Kapustin scholarship, Leonardo was the recipient of a "free" course of his choice by the Southern California Safety Institute (SCSI). According to the instructors, Ladi Mika, Ron Schleede, Mike Dorion, and Caj Frostell, among others, Leonardo was a delightful addition to the thirty "more seasoned" participants of the course. "Leonardo made excellent comments and had challenging questions," said Ron Schleede. And Leonardo concluded that "the course was very valuable to me and I learned a lot." Leonardo obtained a master of science degree in aerospace engineering from Politechnico di Torino in Italy.

Peter Gardiner and Ladi Mika reported that next year's SCSI AAPI course will take place from April 14–25, 2008, again at the CSA Crew Training Center in Prague. ◆

IFALPA Elects Executive Board

The International Federation of Air Line Pilots Associations has elected two members of ISASI to its Executive Board: Capt. Carlos Limon (Mexico) (ISASI MO4875) will serve as president, and Capt. Stu Julian (New Zealand) (ISASI FO3235) will serve as executive vice-president Asia/Pacific for the 2007-2009 term.

Sitting on the full Board are the following: Capts. Paul Rice (USA), Hans Peder Tanderup (Denmark), Richard Woodward (Australia), Georg Fongern (Germany), Dan Adamus (Canada), Mohamad Kheir Hassoun (Lebanon), Salvador Gayon (Mexico), and Henk de Vries (Netherlands). ◆

Flightscape Delivers Lab To AAIB Singapore

Flightscape Inc. (Ottawa) announced in April that the Air Accident Investigation Bureau (AAIB) of Singapore accepted delivery of a flight recorder replay and analysis system for both data and voice/audio.

According to the Flightscape press

release, "The laboratory is an important step forward for the AAIB to better fulfill its investigation mandate and obligations as an ICAO Annex 13 signatory. AAIB recognizes that flight data analysis is paramount to any investigation today. Given that the International Civil Aviation Organization (ICAO) requires states to investigate serious incidents as well as major accidents, AAIB felt it important to acquire a capability and begin to develop expertise."

Flightscape's Insight product line is an internationally recognized platform that greatly facilitates technical collaboration. Flightscape software was originally developed at the Transportation Safety Board of Canada and today is used at 40 accident investigation facilities worldwide by more than 200 accident investigation professionals. More and more airlines are also choosing Flightscape's Insight product suite for their FOQA/FDM accident prevention programs. ◆

ICAO Completes 2006 Aviation Safety Analysis

The International Civil Aviation Organization (ICAO) has completed analysis of the preliminary information available on aviation safety and aviation security for 2006.

Regarding safety in 2006, there were 13 aircraft accidents involving passenger fatalities on scheduled air services worldwide for aircraft with a maximum takeoff mass of more than 2,250 kg, usually seven passengers or more.

Despite an increase in passenger fatalities, the accident rate, measured in fatalities per 100 million passenger-kilometers, increased only marginally from approximately 0.0191 in 2005 to about 0.0193 in 2006. This is due to an increase of around 5% in passenger-kilometers.

For non-scheduled operations, there were 13 accidents involving passenger fatalities for aircraft with a maximum takeoff mass of more than 2,250 kg in 2006, the same as in 2005.

Regarding security in 2006, 16 acts of unlawful interference were recorded in which 2 people were killed and 27 were injured. ◆

NTSB Celebrates 40 Years Of Transportation Safety Improvements

The National Transportation Safety Board reached its 40th anniversary on April 1, having opened its doors April 1, 1967. On that day, the Bureau of Safety was removed from the Civil Aeronautics Board and became the foundation for the new accident investigation agency. Since then, the NTSB has investigated about 130,000 aviation accidents and thousands of accidents in the other modes of transportation: highway, rail, marine, and pipeline.

"I have often said that the NTSB is one of the best bargains in government," NTSB Chairman Mark V. Rosenker said. "With fewer than 400 employees, the Safety Board is responsible for investigating more than 2,000 transportation accidents a year. In our 40 years, our independent investigations have played an important part in improving the safety of every mode of transportation. As a result of the efforts of the Safety Board and other government agencies, manufacturers, operators, and stakeholders, the United States enjoys a safe transportation system that is the envy of the world."

The NTSB is an independent federal agency charged with investigating every civil aviation accident in the United States and major accidents in the other modes of transportation. It is not a regulatory agency; its major product is the safety recommendation, each of which represents a potential safety improvement. In its 40 years, the NTSB has issued some 12,600 safety recommendations, with an average acceptance rate of 82%.

The transportation system has seen many changes since the mid-1960s and experienced substantial growth. The safety of those systems also has increased dramatically. Aviation safety has improved, in part, because investigations now feature digital flight recorders with many hundreds of parameters, where foil recorders 40 years ago provided only five parameters and had to be read out by hand. Equipment or operational problems can now be more readily and confidently identified. Turbine engines are so reliable that twin-engine aircraft are now allowed to fly for thousands of miles over open water. Computers have led to the development of extremely realistic flight simulators, allowing pilots to be trained to handle virtually any conceivable flight condition. Systems developed and installed on airliners—resulting at least in part from NTSB recommendations—have virtually eliminated mid-air collisions and controlled flight into terrain crashes in this country for aircraft so equipped.

If the air carrier accident rate were the same today as it was in 1965, the United States would average a fatal airliner accident every 10 days. Except for the terrorist attacks of 2001—which were deliberate criminal acts—no year since 1990 has seen more than four fatal scheduled air carrier accidents in the United States. The annual number of general aviation crashes has dropped by two-thirds in the last 40 years. ◆

ISASI Rudolf Kapustin Memorial Scholarship Fund Essay *(from page 7)*

Administration are usually seen, though the party system isn't widely known about. Participation of the groups, such as aircraft and powerplant manufacturers, should be made known in the teaching aid. The public also need to see that such an endeavor is more than just a group of people in the field gathering wreckage, since that is the portrayal by the news media.

Most non-aviation people are under the impression that once the field investigation is done, the answers should be blatantly apparent. This would be nice, but unfortunately the public does not realize it is only the beginning of the investigation. Teaching the public which processes the investigation team uses during the investigation may help them see the greater picture. Finally, when it comes down to finding probable causes for the accident, people must be made aware that a single fault does not typically bring down an aircraft. Many faults in sequence are generally required to cause an accident, and those faults aren't just limited to the aircraft itself, something that may seem abstract to non-aviation people. The fact that every aspect of the aircraft's existence, from manufacture to the accident, is examined in depth often eludes people. Digging through manuals, logs, and other data is usually unseen by the public. Avenues of investigation also include researching the pilot's history of instruction, hours, ratings, and capabilities. These revelations may help ease people's question about why investigations take so long to conduct. While these measures won't be the ultimate solution, it may be a step in the right direction.

Overall as time staidly advances, the public and news media will be exposed to more of the air safety investigator's profession. All actions will be examined through a magnifying glass, with the sensational-seeking news media making erroneous theories. The public hears those theories, and hopefully they may take these theories with a grain of salt and a pit of patience after learning more about accident investigation. Hopefully this solution will ease one of the many challenges for air safety investigators. ◆

A Proactive Approach to Solving FDR Readout Problems *(from page 17)*

mended that European regulations be updated "in terms of necessary corrective actions when a mandatory parameter is not correctly recorded or the chronological recording structure does not match the history of the flights performed." The BEA also recommended "a comprehensive calibration program for mandatory parameters measuring and processing channels," so that calibration problems are detected. In order to ensure that some kind of information related to parameter decoding can be retrieved readily by investigators, the BEA recommended that regulatory requirements be defined to get data frame layout information "recorded on FDRs themselves."

Nationally, BEA's study showed that regional civil aviation services have the most appropriate means at their disposal to check the quality of data frame layout documents. As a result, the BEA recommended "that all operators and regional services of the French civil aviation authorities possess identical, up-to-date, and comprehensive data frame layout documents." The BEA also recommended the study of "a formalized report template for the verification of mandatory parameter recordings." The objective is to make FDR recording inspection reports more understandable through standardization.

Through its study, the BEA aimed to alert the aviation community on a global safety problem. Improving FDR recording quality is only possible if most national authorities and operators commit themselves to more-stringent FDR operational serviceability requirements. The safety benefits, though not immediately apparent, are significant enough to justify an additional effort being made and international cooperation being further extended. Improving safety is the way ahead, and realizing the full potential offered by FDRs is the means to achieve it. ◆

Polishing the Apple and the Investigator *(from page 20)*

of personal protective equipment, the hazards associated with hazardous debris, biohazard disposal, as well as jagged metal, pressure vessels, and environmental issues. Unlike a classroom, participants must plan and dress for the elements because outdoor modules are conducted rain or shine, hot or cold, and not always "bug free."

While every accident is an opportunity to learn, so is a simulated accident, and the lessons learned from the exercise can also be applied to incident investigation. If this leads to an improved incident investigation, the chain can be broken before it leads to an accident.

During the three-day, 10-hour-a-day schedule, participants are exposed to some of the same investigative groups used by the NTSB, including Air Traffic Control (ATC), Cockpit Voice Recorders (CVR), Maintenance Records, Operations, Aircraft Structures, and Survival Factors. Each 3-hour module allows participants on-the-spot, practical experience in each specific area. All modules are designed and conducted with the realism of an actual aircraft accident investigation. Students are exposed to normal group work, as well as to simulated issues that have been previously encountered in the field. Students also gain exposure to topics such as cognitive interviewing; they work with the latest technology being used in field investigations. For example, during the structures module, participants will learn how to document the position of flight controls at the time of impact and look for any evidence of inflight failure prior to ground impact. Participants learn the differences between tension loads and compression loads, torque, and transverse shear. They learn how to document wreckage and ground scars by using everything from stake lines to global positioning systems (GPS). Every training module provides the realities one would actually experience during a field investigation, including press briefings at the conclusion of each day.

The course also includes high-altitude flights in an altitude chamber, providing participants educational opportunities generally experienced by only those in the military. The opportunity to actually experience hypoxia, hyperventilation, trapped and evolved gases, cabin pressure emergencies, and rapid decompressions gives participants realistic training and experience that can be applied during future accident investigations as well as increasing their personal safety and that of their passengers.

The synergy developed by ALPA and UND in this joint venture has brought about a successful mission to enhance aviation safety through accident investigation. Joint ventures are not new. However, the key to a successful partnership requires planning and cooperation. By combining the talents of two organizations, the results are increased resources, greater capacity, and increased technical expertise.

An investigation can be overwhelming, confusing, and, if not properly prepared for, dangerous. While classroom instruction is good for passing on general knowledge, a simulated accident site acts as a practicum for this training. Both new and experienced investigators can learn from a simulated accident. New investigators are not only exposed to investigative processes and procedures, but also to long days and group dynamics. Experienced investigators are able to learn about new technology and procedures while passing on some of their experience during the exercise. Also, by bringing together as many of the interested parties as possible, everyone gains respect for what these groups bring to an investigation. While every accident is an opportunity to learn, so is a simulated accident, and the lessons learned from the exercise can also be applied to incident investigation. If this leads to an improved incident investigation, the chain can be broken before it leads to an accident. ◆

Figure 2

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CSAIC Transforms Scientific Research Into Practical Application

(Who's Who is a brief profile of, and prepared by, the represented corporate member organization to enable a more thorough understanding of the organization's role and functions.—Editor)

The Cranfield Safety and Accident Investigation Centre (CSAIC) at Cranfield University is a specialist activity devoted to teaching, research, and consultancy within safety management and investigation, particularly within the aviation industry. The Centre coordinates the activities of four permanent staff as well as a visiting professor, four visiting fellows, and a team of more than 100 external lecturing staff.

Cranfield University has always prided itself on being industry-focused and concerned with transforming scientific research into practical application. This is typified in the way the Centre operates, combining the latest in research and development with the experience of practicing investigators and safety professionals to provide leading-edge education and training to delegates from a broad cross section of the global safety industry.

The University's role in aircraft accident investigation began in 1977 with the creation of a training course in collaboration with what is now the UK Air Accidents Investigation Branch (AAIB). A key element of the program's success has always been its practical focus and impressive line up of experienced presenters. An example of this is the variety of simulated accidents that occur on the University's airport, which investigators work on throughout the course.

Delegates attending the accident investigation courses travel to Cranfield from all over the world. In recent years, this has included investigators from Asia, Africa, Australasia, Europe, and North and South America. CSAIC has also delivered tailored courses for airlines, airports, manufacturers, and government agencies around the world.

As well as short courses, CSAIC offers an innovative MSc program in safety and accident investigation that draws upon modules across the Cranfield and Shrivenham campuses ranging from human factors to forensic science. Launched in 2005, students have already enrolled from organizations such as Rolls-Royce, Bombardier, QinetiQ, and the Royal Navy. Interest in undertaking Ph.D. studies is also high, with eight students currently enrolled in topics including economics of safety, measuring investigator competence, air traffic control safety, engineering human factors, African aviation safety, and health and safety at the accident site.

Cranfield UNIVERSITY

In addition to accident investigation education, the Centre's safety management activities have continued to grow. The safety assessment of aircraft systems course with the UK CAA runs twice a year. Other courses include airside safety management, reliability analysis, flight data monitoring, and hazards awareness for accident site responders. Airline crisis management simulations have been run for governments and airlines alike. CSAIC also ran a 1-day training workshop in investigation management in collaboration with the AAIB and TSB Canada at the 2006 ISASI seminar in Cancun, Mexico.

Aviation remains at the core of the Centre activities, but there are new developments in other areas, too. The work done by Cranfield in helping to set up the UK's new Rail Accident Investigation Branch (RAIB) and developing training for the Marine Accident Investigation Branch (MAIB) has delivered direct benefits to our aviation activities. With investigation agencies in many countries adopting a multimodal approach, Cranfield's diversification has allowed it to work with new clients such as the Australian Transport Safety Bureau and the Dutch Safety Board.

In 2007, Cranfield opened its new accident investigation laboratory, which allows even more "hands-on" teaching through a unique facility. Manufacturers, insurers, and investigation agencies are supporting the development of this lab with exhibits including accident-damaged fixed- and rotary-wing aircraft, engines, and even a boat.

The lab opening coincides with the 30th anniversary of the accident investigation course and will provide a great new addition to the UK's home of accident investigation training. (Website www.csaic.net.) ◆

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