ISASI FORUM

APRIL–JUNE 2003

"AIR SAFETY THROUGH INVESTIGATION"

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ABOUT THE COVER

Shown is FedEx's cargo B-727-232F, Flight 1478, that crashed on its approach to Tallahassee Municipal Airport in Florida on July 26, 2002. There were no fatalities. The plane impacted trees 3,650 feet short of the runway, generally along the runway centerline. The plane descended through trees until impacting the ground about 1,000 feet later. It slid an additional 1,100 feet, most of it in open field, and came to rest about 1,000 feet from the runway facing in the opposite direction of travel. The plane struck construction vehicles that were parked on the field during the night. Burn marks on the ground indicate a fire on the plane for the last 1,000 feet or so of travel. (Photo: Courtesy ALPA)

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AIR SAFETY INVESTIGATORS
INCORPORATED AUGUST 31, 1964

Centennial of Flight Marks Future

By Frank Del Gandio, President

We are fast approaching the centennial of flight. On Dec. 17, 1903, Orville and Wilbur Wright achieved the first controlled and sustained powered flight when they flew for 59 seconds and covered 852 feet. Those 59 seconds began the relentless cycle of nearly continuous future shock in aeronautics. The field continues to change so rapidly that just as we may think we are close to an integrated intellectual understanding of the system, the next major change is well under way and has already made our understanding at least partly outdated.

Pause for just a moment to recognize how quickly those changes have occurred. Within just 30 years of Kitty Hawk, the DC-3 established aviation as a viable system of intercity transportation. Sixteen years later, the sound barrier was broken. Just 8 years after that, mankind first penetrated outer space. Twelve years later, a man walked on the moon, and 400 or more passengers could travel 6,000 miles in a single aircraft. Today, Boeing and Airbus account for more exports than any other two firms in the world.

Though everyone in aviation may have his or her preferred list of "firsts," these few landmarks noted here indicate just how quickly and dramatically aviation has moved from birth to being an assumed fixture of modern life.

Yet, what if that fixture of modern life had not evolved? Think what the world would be like without aviation. Yes, if the Wright brothers had not achieved flight, someone would have, but try to imagine the world without aviation.

Our notions of time and distance would be very different. California would remain several days from Washington, rather than several hours. Europe and Washington would remain about a week apart, while Los Angeles and Tokyo would be still more distant. Suddenly, a business trip from Toronto to London becomes prohibitive. A personal visit to Ireland is relegated to an exotic dream for most of us, and the surgery patient awaiting the arrival of a new kidney may run out of time. In short, aviation has become fundamental to business, leisure, health care, international trade, world employment, and just about any realm of human activity we can identify.

The good news, of course, is that powered flight *did* develop. The Wright brothers drew on the experience and mistakes of the many aviation pioneers who came before them. They selected Kitty Hawk, N.C., because it had the terrain and wind needed to achieve flight. Kitty Hawk is located on the Outer Banks, a narrow shoal just off the coast of North Carolina. Today the Outer Banks is a major center for vacationers and summer homes, but in 1903 it was a harsh, isolated place that offered the Wright brothers the perfect combination of prevailing winds and topography.

Now pause one more time and imagine where aviation and aeronautics might be 50 or 100 years from now, and imagine how the notion of safety will fit in that future environment. For starters, as GPS-based navigation becomes more universal, we also are likely to see a more modest difference in accident rates between rich and middle- or lower-income countries, though some differences likely will remain.

Generally, the system is likely to be more automated 50 years out than we could imagine today, even in our more creative moments. The same is almost certain to be true of

Think what the world would be like without aviation. Yes, if the Wright brothers had not achieved flight, someone would have, but try to imagine the world without aviation.

the way in which we monitor safety from day to day. Our contemporary understanding and execution of quality assurance probably will seem like the Stone Age just 50 years from now (if not much sooner).

Continued automation, broader application of GPS-based technologies, and new ways of monitoring safety are likely to make some types of accidents much less common than they are today. If so, the distribution of accident types will change, and tomorrow's accident investigators may become even more familiar than we are with crew comments like "What's it doing now?"

Finally, accident investigators likely will depend increasingly on technology to understand accidents. Our profession is likely to change enough that few of us could recognize the daily tasks involved some 50 years down the road.

Yet, systems as complex as civil aviation will always incur risks greater than zero. If we assume that human beings will still be part of the flight equation, we will still have accidents, and all too many of them are likely to prove the usual suspects in accident scenarios that are frustratingly resilient. Some flights will still try to land high and hot or low and slow, or remain below adjacent terrain despite all kinds of bells and whistles in the cockpit, etc. Despite all the changes that each of us can imagine, the traditional "tinkicker" will still have a job.

As with the rest of civil aviation, the way in which we perform our basic task is likely to change quite a bit. Yet, the objectives and goals of that task—to understand accident causation and to reduce the frequency of future accidents—will remain very much what they are today. ◆

Searching for Answers

By Ron Schleede, Vice-President

I was very pleased to receive numerous e-mails from ISASI colleagues around the world in response to my comments expressed in the last *Forum*'s "V.P.'s Corner." I received e-mails from five continents, which exemplifies the global membership of our Society. All of the feedback has been very positive and indicates that many others share similar concerns. For obvious reasons, many of the folks asked to keep their views anonymous.

In my earlier message, I had specifically mentioned my observations over the years that many persons and organizations not directly involved in an accident or incident investigation may not gain a full knowledge and understanding of the safety issues involved and lessons learned in the occurrence. Thus, the sole purpose of developing accident prevention measures from the investigation is often lost.

As I mentioned in the previous *Forum,* my observations have been that many aviation safety officials, including pilots, mechanics, flight attendants, etc., rely on Internet and news media coverage of occurrences to understand the safety issues involved, rather than relying on the products of professional investigators.

One of the main themes of the feedback I received pertains to the age-old problem regarding the negative effects that news media and legal systems impose on our investigations and our ability to disseminate safety information. There is an apparent growing trend in some parts of the industry to not disseminate safety information generated during investigations because of potential negative media and legal effects. One person commented that, with few exceptions, flight safety managers are all but forbidden to publish information about accidents and incidents, especially those that occur within their own airline, because of potential media or legal ramifications. This is a chilling statement for those of us involved in the profession of preventing future accidents. How can we try to resolve this issue? Could ISASI and its members play a role? More feedback is welcome.

There were several other excellent issues raised by the feedback that I hope to address in future exchanges. For example, it was suggested that one reason for lack of wider dissemination of safety information is that government accident reports have grown in volume by orders of magnitude to the point they are not read by safety professionals. One of them asked if investigators "were being paid by the pound for their reports?" Another mentioned a report with a 50-page "Executive Summary"! Is this a valid concern? Can we do better?

Another comment addressed concerns about the qualifications of safety managers. Any comments? Is this a concern?

I look forward to hearing from more of you, and seeing many of you at ISASI 2003. Hopefully, we can debate some of these and other issues face-to-face and develop some resolutions. Please contact me at RonSchleede@aol.com. ◆

2002 Annual Seminar Papers Now Available

Active members in good standing and corporate members may acquire, on a no-fee basis, a copy of the *Proceedings of the 33rd International Seminar*, held in Taipei, Taiwan Sept. 30-Oct. 30, 2002, by downloading the information from the appropriate section of the ISASI web page at www.isasi.org. The seminar papers can be found in the "Members" section. Further, 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 2002* 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.

The following papers were presented in Taipei:

- **Session I Keynote Address** *by John Hammerschmidt, NTSB, USA*
- **The Technical Investigation on the Concorde F-BTSC Accident** *by Bernard Bourdon and Yann Torres*
- **Lessons Learned From the Concorde Investigation—U.K. Perspective** *by Robert Carter*
- **Lesson Learned on Near-Miss Accident** *by Hidemasa Takahashi*
- **Session II Keynote Address, Aircraft Accident Investigations in Developing Countries** *by Oetarjo Diran*
- **Effective FOQA Program** *by Samson Yow-Ching, Yeh*
- **Australian Initiatives on Safety Improvement** *by Kym Bills*
- **Regional Differences in Accident Rates and their Global Implications for Improving Aviation Safety: Social, Economic, and Political Factors in Aviation Safety** *by Robert Matthews*
- **From Data Comes Knowledge that Leads to Action** *by Richard Breuhaus*
- **An Outlook on Operational Risk Management and Operational Safety in Chile** *by Claudio Pandolfi*
- **Session III Keynote Address, Global Challenges to Accident Investigation and Safety Improvement** *by Stuart Matthews*
- **Air Accidents Over Water** *by John P. Fish and H. Arnold Carr*
- **Future Flight Data Collection Committee—Recorder Technology for the Next 15 years** *by James Cash and Robert MacIntosh*
- **Identifying Survival Factors Issues in Incident/Accident Investigations** *by Cynthia Keegan*
- **Using Processes Learned in Accident Investigations to Systemically Train Investigators** *by Keith McGuire*
- **Air Transport Safety Information** *by George Joseph and Anthony Concil*
- **Considering Maintenance, Human, and Organizational Factors and Related Errors During Accident and Incident Investigations** *by Bart J. Crotty*
- **Session IV Keynote Address, Global Challenges to Accident Investigation and Safety Improvement** *by Kuo-Cheng Chang*
- **Criminal Liability and Aircraft Accident Investigation** *by Capt. Lindsay Fenwick and Michael C. Huhn*
- **Midair Collision B-757-200 and TU154M on July 1, 2002, near Ueberlingen, Germany** *by Joerg Schoeneberg*
- **Corporate Responsibility and Accountability and their Role in Defense of Air Carriers and Air Agencies in FAA Enforcement Proceedings** *by Michael L. Dworkin*
- **Managing Conflict During Major International Accident Investigations** *by Ronald L. Schleede*
- **Session V Keynote Address, Human Factors** *by Ken Smart*
- **Go Arounds—A Problem for Certain Pilots?** *by Ladislav Mika and Thomas Fakoussa*
- **Mission Operations Safety Audits (MOSA): A Military Version of LOSA** *by Sue Burdekin*
- **The Line Operations Safety Audit—LOSA: An EVA Airways Perspective on a New Approach to Flight Safety** *by Capt. Dale Harris*

2002 Safety Statistics in Historical Perspective

(Reprinted from Airliner Accident Statistics 2002, Jan. 3, 2003, with permission of Harro Ranter/Fabian Lujan Aviation Safety Network; copyright 1996-2003. Source of data is regulatory transportation safety boards, including ICAO, insurance companies, and regional news media. The ASN site may be reached at www.aviation-safety.net.—Editor)

Statistical summary regarding fatal multi-engined airliner accidents

- The 2002 death toll of 1,098 was below the 1972-2001 average death toll of 1,445 casualties.
- The 2002 death toll of 1,098 was below the 1992-2001 average death toll of 1,293 casualties.
- The 2002 number of occupants involved in fatal airliner accidents of 1,335 was lower than the 1992-2001 average of 1,762.
- The 2002 fatality rate (percentage of occupants killed in fatal airliner accidents) of 82 percent was higher than the 1992-2001 average of 73 percent.
- The 2002 number of 37 fatal airliner accidents was far below the 1972-2001 average number of fatal airliner accidents of 50.7 per year.
- The 2002 number of 37 fatal airliner accidents was far below the 1992-2001 average number of fatal airliner accidents of 47 per year.
- The 2002 number of fatal jet airliner accidents of 12 was below the 1972-2001 average of 16.7 accidents per year.
- The 2002 number of fatal prop airliner accidents of 23 was on the 1972-2001 average of 23.3 accidents per year.
- The 2002 number of 1 fatal piston airliner accident was far below the 1972-2001 average of 10.4 accidents.
- The 2002 number of 1 fatal piston airliner accident was far below the 1992-2001 average of 5 accidents.

Number of accidents per manufacturer 2002-1999 (2001, 2000, 1999 figures in parentheses)

Aérospatiale/BAC 0 (0 1 0)	BAe/Avro 0 (1 2 1)	Embraer 2 (0 1 3)	Lockheed 1 (0 1 2)	Tupolev 2 (2 0 1)
Airbus 0 (1 2 0)	CASA 0 (1 0 1)	Fairchild 1 (0 0 0)	PZL Mielec 0 (1 0 0)	Yakovlev 0 (1 1 2)
Antonov 5 (2 5 3)	Consolidated 1 (0 0 0)	Fokker 2 (1 1 2)	Saab 0 (0 1 0)	Yunshuji 0 (0 2 0)
ATR 2 (0 0 2)	Curtiss 0 (0 2 0)	GAF 0 (1 0 0)	Shorts 0 (1 3 0)	Western built 25 (22 29 36)
BAC 1 (0 0 0)	de Havilland Canada 4 (1 3 4)	Hawker Siddeley 1 (0 0 1)	Sud Aviation 0 (1 0 0)	(fmr) Eastern Block built 12 (12 9 9)
Beechcraft 1 (1 1 3)	Dornier 0 (0 0 2)	Ilyushin 1 (2 0 1)	Swearingen 1 (3 1 0)	
Boeing 7 (6 3 5)	(MDD) Douglas 1 (3 4 10)	Let 4 (4 1 2)	Transall 0 (1 0 0)	**Total 37 (34 36 45)**

Number of accidents per country [where the accident happened] 2002 ((2001, 2000, 1999 figures in parentheses)

In 2002 both the United States and Colombia suffered the highest number of fatal airliner accidents: 3. None of the U.S. accidents, however, concerned passenger flights (two firefighting flights and a ferry flight). Of the other countries, Tunisia suffered its first fatal airliner accident when an EgyptAir Boeing 737 crashed on approach to Tunis.

Angola 0 (1 3 3)	Congo (fmr Zaire) 0 (2 1 1)	Iran 2 (1 0 0)	Panama 0 (0 1 0)	Thailand 0 (1 0 0)
Argentina 0 (0 0 1)	Costa Rica 0 (0 1 0)	Italy 0 (1 0 1)	Papua New Guinea 0 (0 0 1)	Tunisia 1 (0 0 0)
Bahamas 0 (0 1 0)	Djibouti 1 (0 0 0)	Ivory Coast 0 (0 1 0)	Philippines 1 (0 1 1)	Turkey 0 (0 0 2)
Bahrain 0 (0 1 0)	Estonia 0 (1 0 0)	Kenya 1 (0 0 1)	Portugal 0 (0 0 1)	U.K. 0 (1 0 2)
Belgium 0 (0 0 1)	Fiji 0 (0 0 1)	Laos 0 (0 1 0)	Russia 2 (4 1 1)	United States 3 (7 7 3)
Botswana 0 (0 0 1)	France (incl. overseas) 0 (1 3 1)	Liberia 1 (0 0 0)	Spain 2 (2 0 0)	Uzbekistan 0 (0 0 1)
Brazil 2 (0 0 1)	Gabon 0 (0 1 0)	Libya 0 (0 1 0)	Serbia & Montenegro 0 (0 0 1)	Vanuatu 0 (0 0 1)
Canada 0 (1 2 3)	Germany 1* (0 0 0)	Luxembourg 1 (0 0 0)	South Africa 1 (0 0 0)	Venezuela 0 (2 0 1)
Cape Verde 0 (0 0 1)	Ghana 0 (0 1 0)	Mexico 1 (1 1 1)	South Korea 1 (0 0 0)	**Total 37 (34 36 45)**
Central African Rep.1 (0 0 0)	Guatemala 0 (1 0 1)	Morocco 1 (0 0 0)	Sri Lanka 0 (0 1 0)	* collision
China 1 (0 1 2)	Hong Kong 0 (0 0 1)	Myanmar 0 (0 0 1)	Surinam 0 (1 0 0)	
Colombia 3 (2 1 4)	India 0 (0 1 0)	Nepal 2 (0 1 3)	Switzerland 0 (1 1 0)	
Comoros 1 (0 0 0)	Indonesia 2 (2 0 0)	Nigeria 2 (1 1 0)	Taiwan 2 (0 1 1)	

Summarized per continent 2002 (2001, 2000, 1999 figures in brackets)

In 2002 Africa was again the most unsafe continent. Nearly 27 percent of all fatal airliner accidents happened in Africa, while Africa only accounts for approximately 3 percent of all world aircraft departures. The moving 10-year average trends show a decrease in the number of fatal accidents for Europe, North-, South-, and Central America over the past 5 to 6 years. Africa, on the other hand, shows an increase from a 10-year average of 5.1 accidents in 1993 to 7.5 accidents in 2002. The average number of accidents per year in Australasia has not been moving much since 1995.

Africa 10 (4 9 9)	Australia 0 (0 0 3)	Europe 7 (10 5 7)	South America 5 (5 1 6)
Asia 11 4 (8 12)	Central America 0 (2 4 2)	North America 4 (9 9 6)	**Total 37 (34 36 45)**

Flight nature

From a passenger's point of view, the year 2002 was the safest year in aviation since Word War II. The number of fatal (non-scheduled) passenger flight accidents was never this low (20), except for 1984. A breakdown by flight nature shows a continuous decrease in the number of scheduled passenger flight accidents over the last 4 years.

The moving 10-year average shows the number of fatal scheduled passenger service accidents decreasing from 24.5 accidents in 1995 to 18.5 accidents in 2002. Firefighting flights were prominent in the news in 2002. In June, a Lockheed Hercules crashed in California following separation of the right wing. One month later, a 58-year old PB4Y-2 Privateer tanker crashed in Colorado following separation of the left wing. These accidents triggered the commission of the Blue Ribbon Panel on Aerial Fire Fighting by the U.S. Forest Service and the Bureau of Land Management. The Panel was chartered to identify key information for planning the safe and effective future of aerial firefighting. The report, released Dec. 6, 2002, contained eight findings and caused the Forest Service and the Bureau of Land Management to no longer contract for the C-130A or PB4Y aircraft as air tankers. Also, the Forest Service suspended fire missions of 19 P-58 Barons and 4 Shorts 330 aircraft pending evaluations of the issues identified in the Blue Ribbon Panel's report.

Summarized per type in 2002 (2001, 2000, 1999 figures in parentheses)

Ambulance 0 (1 0 0)	Non-scheduled Passenger 4 (7 9 4)	Training 0 (1 0 0)	* unknown if these flights were
Ferry 5 (0 0 2)	Para 0 (0 0 1)	Passenger * 4 (3 0 1)	scheduled or non-scheduled
Firefighting 2 (0 1 0)	Positioning 0 (0 1 1)	? 1 (4 2 0)	passenger flights.
Freight 9 (5 9 16)	Scheduled passenger 12 (13 14 19)	- 0 (0 0 1)	**Total 37 (34 36 45)**

Flight phase

2002 did show a rise in the number of approach and landing accidents, which is one of the four most pressing safety problems facing the aviation industry according to the Flight Safety Foundation. In 2002, they accounted for 54 percent of all accidents, compared to 38 percent in 2001.

Summarized per type in 2002 (2001, 2000, 1999 figures in parentheses)

Ground 0 (1 0 0)	Climb 4 (7 11 7)	Approach 18 (12 13 16)	? 1 (1 3 1)
Takeoff 2 (3 3 2)	Cruise 10 (9 3 11)	Landing 2 (1 3 8)	**Total 37 (34 36 45)**

Global Challenges

By Stuart Matthews, President and CEO,
Flight Safety Foundation

(This article was adapted, with permission, from the author's Session III Keynote address entitled Global Challenges to Accident Investigation and Safety Improvement *presented at the ISASI 2002 Seminar in Taipei, Taiwan, October 2002. The full paper is available on the ISASI website at www.isasi.org.—Editor)*

Notwithstanding the horrors of the Sept. 11, 2002, terrorist attacks in New York and Washington, the safety concerns that existed before then have not diminished one iota, and we must not allow ourselves to succumb to the idea that, for the time being, aviation may be safe enough and that security from terrorism is our only concern. The good record of air safety enjoyed today is the product of unrelenting attention to improving the air operation by the constant, sometimes-tedious process of removing safety hazards, one by one.

There is another vitally important component to this safety improvement accomplishment that has contributed immeasurably to achieving the low accident rate that commercial aviation has today: forensic accident investigation. While major effort is properly aimed at accident prevention, so long as accidents continue, the investigation of them to determine causal factors will remain as a vital, prime activity.

Aviation industry growth and safety

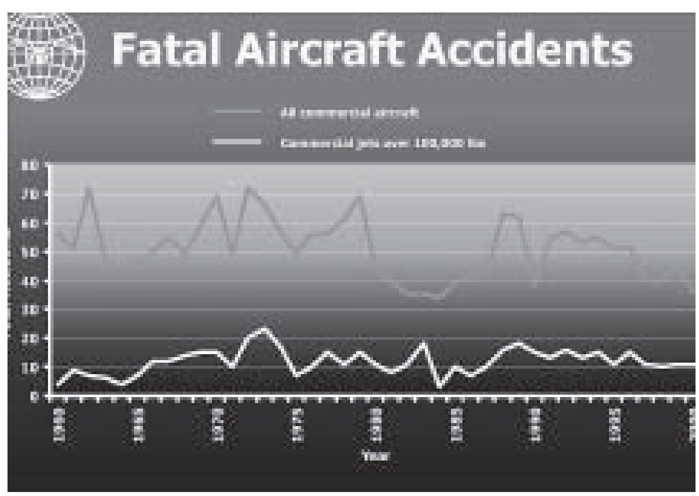
The effects on aviation and air transportation as a result of the recent terrorist activities are profound. The shift in priorities by governments and the private sector to address security concerns is appropriate; however, such transference of attention must not be allowed to affect day-in and day-out operational safety. Many travelers have expressed that they are not afraid of flying per se, but are irritated with delays of security processing procedures that many perceive as unrelated to actual threats. Many others who are "white knuckle" flyers anyway are even more reluctant to fly now. If operational safety levels are allowed to slip, the likelihood of an airline industry, already on the economic ropes, losing more passengers is a matter of great concern.

I would contend that with the advent of new aircraft capable of carrying maybe as many as 500 or more passengers, a safety-related accident would create worldwide concern every bit as serious as another major terrorist attack. It is important, therefore, to ensure that the highest possible levels of operational safety are achieved and maintained, and the relatively few accidents that do occur bear out the reality that flying is indeed safe and is steadily getting safer.

Nevertheless, safety professionals will never be satisfied with anything less than elimination of fatal accidents. To this end, the Flight Safety Foundation (FSF) has led teams of experts from other domestic and international organizations, both private and government, in a series of special studies and analyses that focus on identifying and understanding the root causes of mishaps that lead to accidents. ISASI and its many individual, corporate, and government members likewise continue to refine the investigative process that is so vital to uncovering the factors that combine to result in catastrophes. Prevention and investigation are thus linked as a powerful force to reduce loss of life and property in our business.

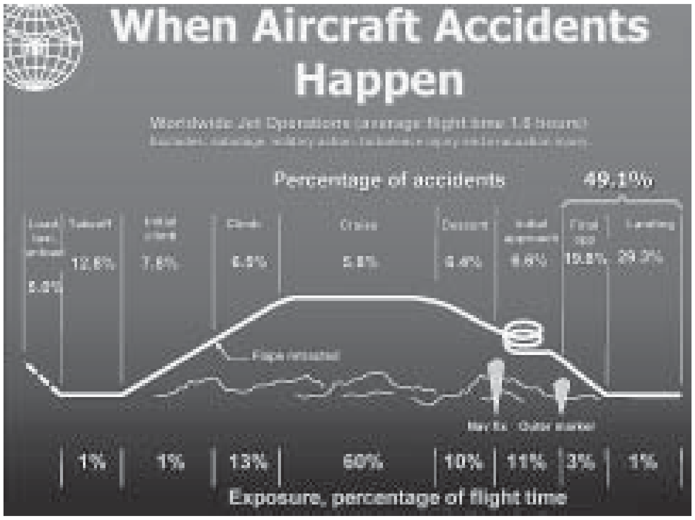
Accident prevention

About half of all accidents occur during approach and landing, and controlled flight into terrain (CFIT) continues to be the cause of most aviation fatalities. Building on earlier work done by industry and government research organizations, FSF



About the Author: Stuart Matthews *has been president and chief executive officer of the Flight Safety Foundation since 1994, when he retired as head of Fokker Aircraft USA, which he directed for 20 years. Born in London, England, he has more than 43 years of aviation industry experience, including 15 years as an advanced project design engineer, followed by 7 years as corporate and fleet planner for British Caledonian Airways. He is a chartered engineer, a fellow of the Royal Aeronautical Society, a fellow of the Chartered Institute of Transport, and an associate fellow of the American Institute of Aeronautics and Astronautics. Upon his retirement from Fokker, he was knighted by the queen of the Netherlands for his services to aviation.*

to Safe Flight



has developed useable information about windshear avoidance and airline safety management. A few years ago, FSF focused extensively on CFIT avoidance, leading an industry effort that culminated in the production of an extensive education and training aid.

Most recently, we have concentrated on approach and landing accident reduction (ALAR) and have now produced a major training aid, our ALAR Tool Kit, that contains many recommendations, briefings, videos, standard operating procedures, and much more. More than 300 aviation professionals around the world contributed to the development of this aid, and it is one of the most significant things that FSF has ever produced. Significantly, many of the recommendations contained in it have been accepted by both the FAA in the United States and the JAA in Europe, and these will now form the basis for new large aircraft training requirements.

The variability of safety risk among the myriad routes flown between the various origins and destinations around the globe is much too wide, considering the collective knowledge of accident avoidance technologies and techniques we have at our disposal. Nevertheless, the spate of accidents in the past few months has shown that CFIT continues to be very much alive and well.

For FSF, it is encouraging that all over the world, airlines and corporate operators are giving attention, through our ALAR program, to approach and landing accidents, which account for half of all aviation accidents. There are indications that some accidents have been prevented by possession and application of the knowledge and techniques furnished through this program. However, although much work is under way by numerous task forces around the world, it is a major effort and widespread implementation remains a challenge.

Accident investigation

Despite the best efforts at preventing accidents, flaws inevitably appear in the design, manufacturing, and operating processes, creating latent conditions that by themselves are benign. Combined with other unforeseen, but commonly occurring, actions that may not be up to standard, these latent conditions can often become activated, generating a chain of events that leads to the catastrophe itself.

Accident prevention and the energies that sustain it are seldom prophetic. Coupled with lessons learned from accident investigation, however, the body of knowledge and experience is steadily increased and critical decision-making in all parts of the design, manufacture, and operation should be expected to improve. The investigative process, building on the knowledge base put in place by predecessor investigators, explains not only what happened and how it happened, but also provides information that may enable analysis to determine why the accident happened. This knowledge then forms a feedback loop into the prevention process.

Neither accident investigation nor accident prevention by themselves will suffice to achieve the mutual goals of reduced loss of life and property. They form a symbiotic relationship that is far more powerful than the sum of each. For this symbiosis to occur, cooperation and communication must be emphasized as the enabling mechanisms.

An example of incomplete or non-existent operational communication is the Air Florida accident on the Potomac River on Jan. 13, 1982, where rescue efforts were critically hampered by the lack of ability among the three jurisdictional emergency agencies to communicate with each other. The worldwide aviation community has since responded with increased attention to practice disaster drills that, among other benefits, can reveal such weaknesses in our communications effectiveness.

Information and knowledge

Accident prevention is not a physical entity that can be manufactured or "operated" with predictable results. It is the application of knowledge and understanding to the operation of the aircraft within the operating system in such a way that the safe completion of the intended journey is ensured. As such, it is a totally human-intensive process and therefore subject to the shortcomings and foibles of the old Mk. I human being! (No effective modifications have been made to *this* organism!)

Accident prevention is dependent upon the constant refreshing of the knowledge base to ensure its applicability to the various technological advances in aircraft, powerplants, air traffic systems, communication systems, airports, weather knowledge, etc. The knowledge base is fed by many inputs,

More than 300 aviation professionals around the world contributed to the development of ALAR Tool Kit, and it is one of the most significant things that the Flight Safety Foundation has ever produced.

not the least of which is the investigation process that determines what, where, when, how, and why the event(s) took place. The largest body of information is derived from good, solid detective work, using the entire arsenal of technical tools to determine physical failures.

But this by itself is incomplete without knowing how the human interacted with the design, manufacture, and operation of the system's components. The overall process must embrace analysis and understanding of the activities of the humans associated with each phase of the activities leading up to the event itself. Analysis frequently reveals flaws in processes or failure of the human component to comply with procedures that have been established to minimize system failures.

Constant renewal and upgrading of the art and science of accident investigation requires the acquisition and integration of new information into the knowledge base. New tools in the form of new technological capabilities, analytical techniques, data processing, and the like flow gradually into the investigator's toolkit. While the constant upgrading of tools is important, the accident investigator continues to play the crucial role in the process, requiring a skillful blending of technical expertise, experience, operational competence, and judgment. The tools expand the investigator's capabilities and often reduce the time required to arrive at closure on individual aspects of an investigation.

Additional investigative tools

As good as accident investigation is, with the continued improvement in available technology, today there are a number of additional tools and things that could be done to provide more information more quickly that would help speed up the investigation process. While none of the following proposals are absolutely new, it is worth repeating them to ensure that they are not forgotten.

Cockpit voice recorders (CVR) have assisted in past accident investigations but are currently limited to 30-minute recording loops. Why not extend the recording loop for a much longer period? A 2-hour loop has been suggested, and there seems little reason to prevent it being done.

Digital flight data recorders (DFDRs), invaluable as they have been, are still lacking in many ways. Limited originally by the prevailing technology to record only a relatively few parameters, regulations now require 88 parameters be recorded. While this is a significant increase, new-generation aircraft have the capability for measuring more than 12 times that number—the Boeing 777, for instance, can record 1,384 pieces of information on its DFDR. Many airlines are already collecting hundreds of parameters as part of their regular flight data monitoring programs. That being the case, why not do the same for the accident recorder?

However, there is another problem with DFDRs that has plagued numerous accident investigations in recent years. TWA 800 and more recently the tragic CI 611 are examples. Something catastrophic suddenly occurred to both aircraft; but, in both cases, at the moment it happened, the DFDRs stopped. Presumably this was due to a loss of electrical power supply, but why not have an internal power source that would have allowed them to continue operating? Of course I realize that it is not as easy as that and some power source would also be required by the sensors supplying the information, so I am not going to suggest that this could be done easily. Nevertheless, could not technical experts engineer a solution to this problem?

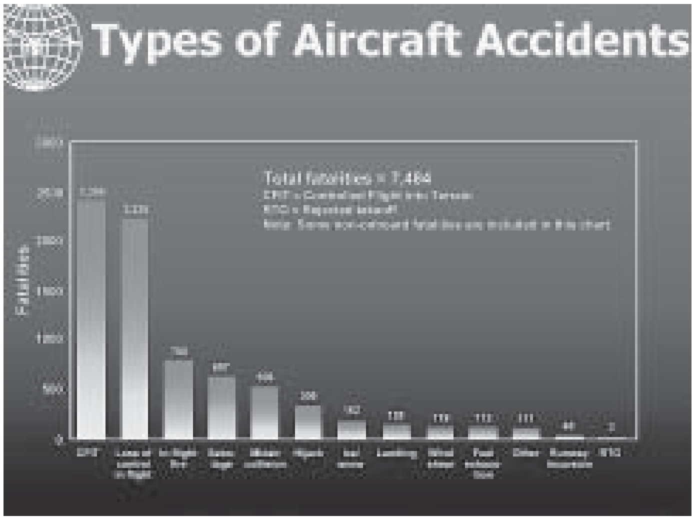
Having proposed that, another question arises—why do we have to continue to rely on the DFDR at all? Quite often after an accident, enormous effort is expended on just finding the "black box." This is frequently a time-consuming exercise and, in many cases such as when it is at the bottom of the ocean, horrendously expensive. Recall TWA 800, CI 611, KAL 007, among many others. Additionally, sometimes the recorder is found to be unreadable as a result of the trauma it experienced.

In contrast, there is the Airbus that crashed on takeoff for a test flight. In that accident, the full circumstances were known the following day without having to find and examine the DFDR. The reason for this was that data from a very large number of parameters were being recorded on board the aircraft and being sent by datalink to a ground station that recorded the information. The use of telemetry allowed for immediate readout and analysis.

Telemetry could also be used on commercial aircraft. Satellite communication and datalinks to a ground station would allow continuous monitoring of a flight in progress in real time anywhere in the world. Surface shipping companies routinely monitor the location and some operating parameters of oil tankers and cargo vessels across the globe. For aircraft, the need for an especially hardened onboard DFDR would be eliminated, and, apart from assisting in accident investigation, automatic real-time monitoring could actually be used for accident prevention.

Indeed, some airline maintenance departments are already utilizing datalink technologies for on-condition monitoring of aircraft powerplants and other systems as a quality-assurance tool. Such technologies could automatically detect emerging abnormalities and alert the pilot so appropriate action could be taken to forestall a catastrophe in many cases. Ground personnel could assist in diagnosis of the problem and help the aircrew in making the best decision to mitigate it. The United Airlines' Sioux City control systems failure accident was helped by voice communication linkup with ground maintenance and operational people. Having a parameter transmission datalink would seem to augment such aid immensely. These capabilities could not only prevent serious incidents and accidents, injuries, and lost lives, but also improve operational efficiency and capture significant cost savings.

Notably, there would be a need to ensure privacy and commercial security, and one should not underestimate its importance nor the difficulty of devising a process that will please



all parties affected. However, the technology to implement a secure system, as outlined, does exist. Undoubtedly, the expense of implementing such a system would be significant, but this would surely be offset in large part by improved efficiencies, the savings resulting from fewer accidents, and the reduced cost of accident investigations themselves. For these reasons alone, telemetry systems deserve serious consideration.

Finally, there is the issue of video cameras in the cockpit. This is a very contentious subject that requires very careful handling. Nevertheless, given the privacy and other such safeguards that are absolutely necessary and that must be ensured, a video recorder showing what went on in the cockpit prior to an accident would be an advantage—not in every case, but certainly in many.

Apart from the well-known EgyptAir and SilkAir cases, how many times do we read in accident CVR transcripts things like "unknown sound—possibly the sound of flap extension lever being selected" or something similar? Something like that appeared in the CVR transcript so far released by the ASC on the recent tragic CI 611 accident, referring to "chirping" sounds.

It is essential for the continued enhancement of flight safety that investigators know precisely what was going on in the cockpit. Accident investigation could benefit in many cases from video recorder records. I realize full well that there is opposition to such proposals, but safeguards can be effected, and video recorders in the cockpit should be given serious consideration as a means of helping accident investigation and through it, improving safety.

Blame-finding

The aircraft accident investigation process was wisely crafted and has evolved over many years to determine probable cause(s), quite apart from finding blame or liability. That vital and unique separation of purpose has served aviation safety well for a century of progress.

However, in recent years, a growing tendency to blur the boundaries between the investigation and the accompanying legal proceedings has resulted in new challenges to effective, objective accident investigation. Protection of data and information essential to the finding of causal factors is now often threatened by this developing situation, so that information may be hard to come by.

The manifestation of these threats can be briefly described: First, in the United States in particular, the growing litigiousness of society has made the search for someone to blame much more intense over the past two decades or so. There is nothing like the fear of losing one's job, or besmirching of reputation, to feed a reluctance to cooperate in supplying information that may be vital to cause determination as well as detrimental to one's own reputation or livelihood!

Second, cultural customs or government policies within a country may be "blame centered," so that one is disgraced or punished severely if found to have been lax, inadvertently or not. A situation like this also discourages the flow of information.

Third, company cultures may favor penalties for human error, so that concealing one's own mistakes is, in effect, encouraged.

To each of these situations has been added a fourth danger to effective accident investigation—the growing incidence of criminalization of accident parties, beginning even before the accident investigation is completed. There is no question that there is a place for criminal prosecution, where warranted. But determining what constitutes appropriateness of criminal procedures is a hot topic of debate at the present time. The prosecutorial process is taking place both intra- and inter-country, which forecloses any prompt resolution of the problem associated with it.

In some countries, local jurisdiction of where the accident occurs prevails over a national jurisdiction insofar as prosecutorial actions are concerned. Depending on a given nation's laws and culture, this situation may or may not affect or impede a determination of cause. Remedy is beyond the control of airlines, accident authorities, or individual Civil Aviation Authorities themselves. It involves a long and arduous public education undertaking that aims to provide an understanding that it is in the best interests of the traveling public to have an open as possible accident investigation, so that causes can be determined and preventive measures be devised quickly, in order to reduce or prevent further loss of lives and property.

Remedy may likely also involve some realignment of relationships within a country's government that may, in fact, be difficult or impossible. At the very least, it will certainly involve a debate of local versus central government rights and responsibilities. Harmonization of judicial, legislative, and executive elements of government may be required to clearly delineate responsibilities and limitations to afford protection to the investigative process. Following the issuance of the accident report, legal processes for liability can proceed, but use of information derived in the accident investigation itself must be denied the prosecution. They should develop their own parallel investigation and use only their information.

Flight Safety Foundation's ICARUS Committee is undertaking a study of the criminalization problem as it relates to air safety improvement. It is expected that this study will continue well into 2003. Accident investigation is costly, as is the implementation of its findings into preventive measures. But it is not nearly as costly as doing nothing to improve the process. Clearly, ever-better tools and unimpeded investigation are ways in which the process can be improved. ◆

The Air Accident Investigation Process

In the continuous efforts to improve aviation safety standards, few would dispute the contribution of air accident investigation organizations that use their expertise to try and ensure the future safety of all those who fly.

By Michelle Doherty

(Michelle Doherty, staff writer for U.K.-based Touchdown, *The Commercial Airline Safety & Training Magazine, compares the differing approaches to air accident investigations by the U.K.'s Air Accident Investigation Branch (AAIB) and the U.S.'s National Transportation Safety Board (NTSB). This article is reprinted with permission from* Touchdown, *Vol.2 Issue 4, 2002, Andover, Hampshire, U.K.—Editor)*

It may not be widely publicized, but accident investigation teams around the world have played a critical role in improving aviation safety. By determining the circumstances and causes of accidents, numerous safety recommendations have been made and some potential accidents avoided.

Although each country may have a slightly different approach to air accident investigation, there are guidelines set down by the International Civil Aviation Organization (ICAO) that ensure adherence to certain common procedures. The decision as to who investigates is set out in Article 26 of the Chicago Convention, which specifies that the State in which an accident occurs is obligated to conduct an investigation. However, other countries with an interest may be involved; for example, the accident may have occurred in France but the aircraft may have been built in the United States and operated by U.K. carriers. Whoever investigates, the general consensus is that the objective of the inquiry is the prevention of accidents and not to apportion blame. However there are occasions when a country's report is called into question, and, under an ICAO regulation, an accredited representative can either append an attachment to a report or publish a separate report.

While the more affluent countries with large commercial flight operation have teams of experienced professionals and resources to handle major investigations, poor standards do exist in other areas of the world, and this can seriously compromise the outcome of an inquiry. *Touchdown* asked Ken Smart, Chief Inspector of Air Accidents at the AAIB, about this matter. "Those countries that are restricted in terms of technology or finances are often assisted by a larger State that perhaps has an interest—usually the United States."

There have been occasions where the findings of an inquiry have resulted in conflict, such as with the Singapore Airlines SQ006 investigation. Singapore's Ministry of Transport was dissatisfied with the conclusions and recommendations made by Taiwan's Aviation Safety Council (ASC), and said it should have been able to participate in the analysis process in accordance with its entitlements under Annex 13 of the Chicago Convention

The U.S.'s NTSB is set apart in having a multimodel system where a number of parties are involved in the proceedings. This means that as well as having a core team of investigators known as the "Go Team," the NTSB will also draft in other organizations that have the technical expertise to significantly contribute to the investigation. With the exception of the FAA, which is automatically included, this will generally include groups such as the aircraft manufacturer or the local air traffic control. For obvious reasons, the NTSB is careful not to include any legal representatives in this group

With its headquarters in Washington, D.C., the NTSB also has nine regional offices around the country and a head count of about 400 staff. Unlike the AAIB, it is responsible for all transportation accident investigations around the United States, not just for air accidents.

Touchdown asked Paul Schlamm of NTSB's Public Affairs Department what sort of professional background investigators come from.

"Most of our people are trained pilots and many of them also have a military investigation background," says Schlamm. "In the United States, military air accidents are not handled by the NTSB, but we do assist in their investigations should it be required."

Within the Go Team are specialists who work under the Investigator-in-Charge (IIC). Each specialist is responsible for a defined area of investigation in one of the following categories: Operations, Structures, Powerplants, Systems, Air Traffic Control, and Weather. As well as the "Party Groups," it is usual for 12-20 investigators to be sent to the accident site.

In the U.K., the Air Accident Investigation Branch (AAIB) keep matters more "in house." An independent Inspectorate of the U.K. Department for Transport reporting directly to the Secretary of State for Transport, the team is made up of about 30 inspectors who are supported by an administration team. They are classified as either Engineering or Operations Specialists, and one group deals primarily with flight data recorders.

All the inspectors have extensive experience within the aviation industry and are trained pilots, the Operation Inspectors being former commercial airline pilots. The size of the team will depend on the type of accident but will usually consist of at least a pilot, an engineer, and a Flight Data Recording Specialist. A pathologist from the Royal Air Force (RAF) may also be part of the investigation team if the accident involves fatalities.

With major disasters, the AAIB may set up a "Group Investigation," which means an IIC will preside over a number of investigation groups each headed by an AAIB Inspector. Each group will be given the task of investigating a specific aspect of the accident and may include specialists from outside the AAIB, such as the operator, manufacturer, or an accredited representative from any other State with a special interest. However, unlike the NTSB, the AAIB oversees and maintains control of all areas of the investigation at all times.

Minor accidents involving private aircraft and no casualties may lead to the Duty Coordinator deciding a formal investigation is not required. In this case the AAIB issues an Accident Report Form, which needs to be filled out and returned to the AAIB within 10 days. An inspector will then talk to the pilot and decide if any further action is required.

Touchdown asked Paul Schlamm what happens with smaller accidents in the United States.

"We will usually have one of our regional offices send out a couple of investigators even if the accident has been fairly minor. However, in some cases the pilot will just file an incident report directly with the FAA."

In both the United States and the U.K., when an accident is reported a Duty Coordinator will be in direct contact with the emergency services, air traffic control, and the aircraft operator. Once aware of the initial facts, the Coordinator will be able to determine the required level of response.

In cases of suspected criminal activity, Her Majesty's Coroner or Procurator Fiscal (in Scotland) will hold an inquest or fatal accident inquiry. AAIB Inspectors are required to prepare statements for the court and are often required to appear as expert witnesses. In the United States, the FBI takes over the investigation and is supported by the NTSB, if requested

Air Accidents Investigation Branch

The AAIB is an independent Inspectorate of the U.K. Department for Transport reporting directly to the Secretary of State for Transport. The team is made up of about 30 inspectors who are supported by an administration team.

Despite any organizational differences, the NTSB and the AAIB will still need to collect and analyze the same information, although to which degree will naturally depend on the seriousness and type of accident.

First and foremost, it is extremely important that the accident site is sealed off as soon as possible, and in both the U.K. and the United States this is the responsibility of the police. Although the emergency services must be allowed to carry out their jobs without hindrance, they are encouraged to refrain from unnecessarily disturbing any wreckage or equipment as this may turn out to be vital evidence. A coordinator will then appoint a team of inspectors to handle the investigation, and the team will travel to the accident scene immediately.

Once the team arrives at the scene and the rescue and firefighting operation is over, the "Field Phase" of the investigation begins. The inspectors will ensure the site is safe and then proceed to examine and record the evidence present.

This phase will be well-documented with photos of the site and plans of the distribution of the wreckage pinpointing its exact position. This will enable the investigators to calculate impact angles to help determine the plane's pre-impact course and attitude.

Statements from any survivors or witnesses are extremely important in trying to understand what happened prior to the accident, and in some cases the initial statements may have been taken down by the police for the investigation team to follow up. The police are also encouraged to keep a comprehensive record—and photographs/video if possible of any events that occur before an investigation team arrives, especially if wreckage has been moved.

Most importantly, the flight recorders need to be retrieved and taken away for analysis. Modern-day flight data recorders (FDRs) use digital technology and memory chips and can monitor around 3,000 parameters, which include air speed, altitude, and heading. Although they may not always determine the cause of an accident, they can save accident investigators weeks of work. The data gathered can also be programmed into computer animation systems, which allow the team to reconstruct and view the conditions prevalent at the time of the accident. The team may also liaise with the aircraft manufacturer regarding the information obtained from the FDR.

Cockpit voice recorders (CVRs) generally record on either a 30- or 120-minute loop and can capture not only the communication between the flight crew, but also other sounds within the cockpit. At the AAIB, a "library" of these background sounds is used to aid identification. The CVR data, due to their sensitive nature, are generally treated as confidential.

Fitted with Dukane beacons to facilitate recovery and able to withstand severe forces, the flight recorders are perhaps the investigator's most invaluable tool as the recorders offer detailed, yet impartial, evidence. They are also sometimes the only piece of the aircraft to survive intact.

Another factor for the investigation team to study will be the weather conditions present around the time and the area of the accident. Meteorological reports will be looked at in detail to see if weather had any bearing on the accident.

In the U.K., once the initial field investigation is over, the Chief Inspector will decide if the accident is serious enough to warrant an Inspector's Investigation resulting in a report submitted to the Secretary of State. If it is decided that a field investigation will suffice, the report will be published in an AAIB bulletin. The draft reports of investigations must be shown to all the concerned parties before the reports are finalized so that they may dispute any evidence, if necessary.

In larger investigations, once the field phase is over, inspectors will continue to investigate all aspects of the flight's operations in more depth, including any relevant documents regarding the aircraft's operation. They will also take into account the history of the flight and at what phase of the flight the accident occurred as well as any data concerning airfield operations.

Wreckage and any other material evidence may be moved to another area better equipped for further examination and testing, usually the investigation team's headquarters. Once removed, the wreckage may be pieced back together in an attempt to understand where and why the aircraft structure may have failed.

Air traffic control (ATC) radar data and transcripts of the radio transmissions between the flight crew and ATC will be studied, which may also include the reconstruction of the air traffic services given to the plane.

The performance of the flight crew will also be investigated. This may involve looking at records of the crew's training and experience, flying procedures and techniques, their duties in the days preceding the accident, as well as any other factors that may have resulted in human error, such as their health, medication, or fatigue.

On the engineering side of the investigation, the aircraft's powerplants, the engines and their accessories, and propellers, if applicable, will be studied. The hydraulic, electrical, pneumatic, and associated systems components will also be looked at as will the flight control system.

With as many as 75 percent of accidents classed as survivable, a number of fatalities arise due to post-impact factors. With this in mind, "survival factors" has become another important area of investigation. This will involve determining impact forces and documenting injuries. If there have been fatalities, post mortems will be held by a pathology team to establish the exact cause of death in relation to where individuals were seated on the aircraft, as some people may have died as a result of post-accident fire rather than impact forces. If applicable, all aspects of the evacuation of the aircraft will be looked at, which may include the performance of the cabin crew, community emergency planning, and all the emergency service rescue efforts.

As well as having a core team of investigators known as the "Go Team," the NTSB will also draft in other organizations that have the technical expertise to significantly contribute to the investigation.

"Management factors" is a more recent consideration in accident investigations and involves looking at how a company's management policies, operations, or regulations may have played a part in causing an accident.

Larger investigation teams such as the AAIB and the NTSB also have a database of previous accidents and investigations. This enables the team to cross-check information and see if it has data on any accidents with similar characteristics, which may help them with the current investigation.

Post-investigation

So what happens once the information gathered from the accident site has been analyzed and conclusions drawn?

In the United States, when a Party Group has finished investigating, its chairman will provide a report on its conclusions, which is then placed in a public docket. When all the separate reports have been completed, the NTSB will draft a final report of which the Party Groups are not involved. They may, however, submit their findings and propose safety recommendations. The NTSB then conducts a public board meeting in Washington, D.C., [or other applicable location] to deliberate over the findings. A final draft, including the Board's conclusions, will then be available on its website several weeks later.

At the AAIB, once the team is satisfied that it has covered all relevant areas and established the probable cause/causes of the accident, it will draft a report and make any necessary safety recommendations. A draft copy of the report will be sent to any parties that may be adversely affected by the outcome. These parties will then have up to 28 days to make any representations before a final report is published.

Although the NTSB and the AAIB both have impressive records, the procedures are distinctly different. The U.K. system is more of an evolutionary process whereas the United States adopts more of an information synthesis approach. With accident investigation being, as Ken Smart said, "like piecing together a puzzle" one might wonder if the U.S. system, with its separate teams and initial reporting system, may impede the early passing of crucial information to another area of the investigation. That said, Paul Schlamm points out what he considers to be the plus side of the NTSB method.

"Developed over the past 30 years and with all the experience and knowledge those years bring, the benefit of our system is that all the information gathered and its analysis is impartial," he says.

That said, there has been cause for concern regarding the NTSB's party system. Combined with the Freedom of Information Act, it has been criticized for encouraging early public hearings and putting witnesses and investigators under pressure to provide answers that may lead to litigation at a later date.

As always, the challenge facing the industry is to reduce the accident rate further, despite the increase in flight hours. Although advances in technology are aiding the accident investigation process, some within the industry believe this is not enough and that too much emphasis is placed on finding a primary cause. C.O. Miller, former head of the NTSB Bureau of Aviation Safety, says, "Universal recognition is needed that all accidents, when investigated thoroughly, involve complex sequences of events. But to dwell on a single cause or even assign priority to causes is to oversimplify an accident and thereby reduce the prevention potential of an inquiry." ◆

Improving Chances To Survive

The survival factors issues identified in investigations illustrate the variety of ways in which National Transportation Safety Board investigators identify and develop improvements in aircraft and occupant safety.

By Cynthia L. Keegan
Survival Factors Investigator/
Engineer, NTSB

(This article was adapted, with permission, from the author's technical paper entitled Identifying Survival Factors Issues in Incident/Accident Investigations*, presented at the ISASI 2002 Seminar in Taipei, Taiwan, October 2002. The full paper is available on the ISASI website at www.isasi.org.—Editor)*

Identifying survival factors issues in incident and accident investigations not only allows investigators to learn from the events, but it is also important to share information with organizations that can make improvements in occupant survivability. Not every accident will generate recommendations to improve survivability, but every survivability investigation can build a foundation for future improvements.

The survival factors issues discussed below were identified in accidents that may not have had the high visibility of say, the McDonnell Douglas MD-82 runway overrun during landing accident in Little Rock, Ark., on June 1, 1999, but are equally important. Indeed the identified survival factors show the effect of investigating survivability issues in a comprehensive manner, and may provide valuable information to airline training departments, equipment design engineers, airplane manufacturers, and others who have an interest in improving occupant survivability.

The accident investigations discussed involve one commercial air carrier's aircraft and two general aviation accidents, and illustrate the variety of investigations conducted by survival factors investigators. The first accident involved the explosive decompression of an Airbus A300 that fatally injured a flight attendant. The second accident involved the incapacitation of a general aviation pilot because of muffler erosion and carbon monoxide entering the cabin in flight, and the third accident involved the drowning of a female passenger during the ditching of a sightseeing flight in the Pacific Ocean. The survival factors issues identified in these investigations illustrate the variety of ways in which National Transportation Safety Board investigators identify and develop improvements in aircraft and occupant safety.

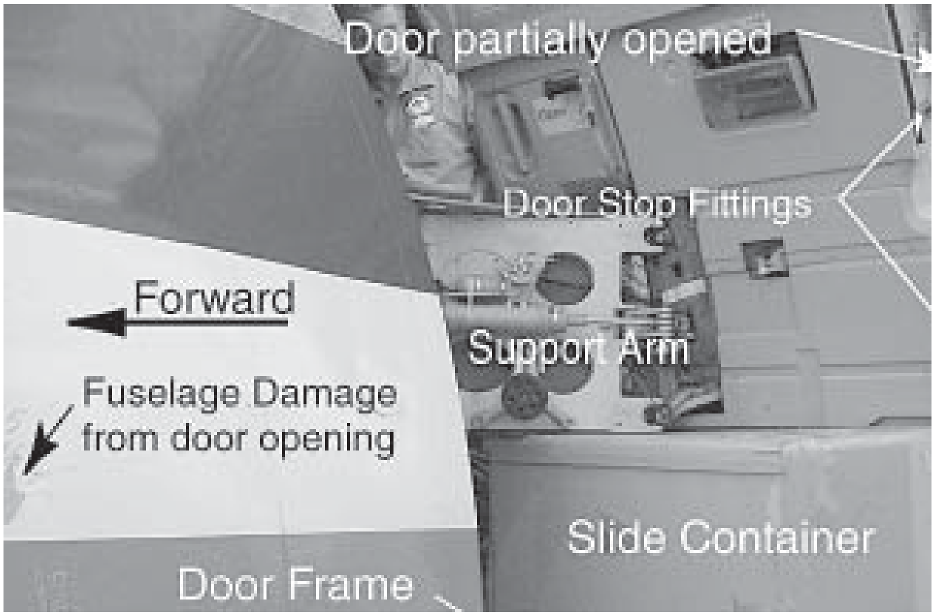
Explosive decompression

On Nov. 20, 2001, a flight attendant, who was also the purser, on board American Airlines (AA) Flight 1291 opened the left front (1L) emergency exit door during an emergency evacuation and was ejected to the ground and killed. The airplane, an Airbus A300, was enroute from Miami International Airport (MIA), Miami, Fla., to Porte au Prince, Haiti. It had been airborne for about 8 minutes when the flight crew encountered a problem with the automatic pressurization system. About 11 minutes after departure, the flight crew informed ATC that the flight would return to MIA.

During the return to MIA, flight attendant call chimes sounded erratically, and the lavatory smoke detectors sounded continually. Passengers and cabin crewmembers complained about pressure in their ears, and flight attendants in the aft cabin heard a hissing sound coming from the 4R emergency exit door. About 3 minutes before landing, the captain declared an emergency and requested that aircraft rescue and firefighting (ARFF) personnel standby for the landing.

After the airplane landed at MIA, a flight attendant reported smelling smoke to the flight crew. The captain observed the "cargo loop light" illuminate and ordered an emergency evacuation of the airplane. The flight attendants heard the evacuation alarm and attempted to open the emergency exit doors. However, none of the doors would open. One flight attendant requested, and received, assistance from a passenger to open the 3L emergency exit door. When they forced the door handle upward, the handle assembly broke and the door became unusable. Flight attendants at the 3L and 4L emergency exit doors announced to passengers that their exits were blocked, and a flight attendant reported to the flight crew that the doors would not open. While the purser was struggling to open the 1L emergency exit door, the door suddenly burst open, forcibly ejecting him onto the ramp and killing him.

__About the Author: Cindy Keegan__ is a Survival Factors Engineer for the NTSB in Washington, D.C., and joined the agency in 1992. Keegan received her bachelor of science degree from Embry-Riddle Aeronautical University (ERAU) in Daytona Beach, Fla., and worked as a production engineer for the McDonnell Douglas Aircraft Company from 1985 through 1992. She assisted the Aviation Safety Council (ASC) with the investigation of the Uni Airlines MD-90 accident in Hua Lien, Taiwan, and the Singapore Airlines Boeing 747 accident in Taipei, Taiwan. She also recently assisted with identifying the airplane wreckage of hijacked American Airlines Flight 77, which crashed into the Pentagon on Sept. 11, 2001.



Preliminary findings from the investigation revealed that loose insulation blankets blocked the outflow valves that normally release cabin pressure, and that the excess air pressure inside the cabin caused the door to burst open when the purser attempted to open the 1L door. After the 1L emergency exit door exploded open, all of the other emergency exit doors with handles in the open position opened and their escape slides deployed.

According to Airbus, a person of the same size and stature (183 pounds and 5 feet 10 inches tall) as the purser could exert enough force on the door handle to open the emergency exit even if the airplane is overpressurized. The A300 emergency exit door opens by moving the door handle upward, which sequentially moves the door upward, outward, and forward parallel to the fuselage. The door's lower connecting link moves the door up and over the fuselage stop fittings allowing the door to open outwards. Examination of the damaged 1L exit door found that the door's stop fitting pins were flattened, consistent with the door's stop fittings rubbing against the fuselage stop fittings as the purser forced the door open. The A300 emergency exit doors open outward and do not have built-in systems to relieve pressure before the door opens.

During the investigation of this accident, the Safety Board also examined other airplane emergency exit door designs. The Board found that many other airplanes are designed with plug doors that first open inward before they open outward and that cannot be opened when the cabin is pressurized. On one series of aircraft, the emergency exit doors are equipped with vent doors that are linked to the door handle and to pressure detection and relief systems that relieve pressure before the door can be opened.

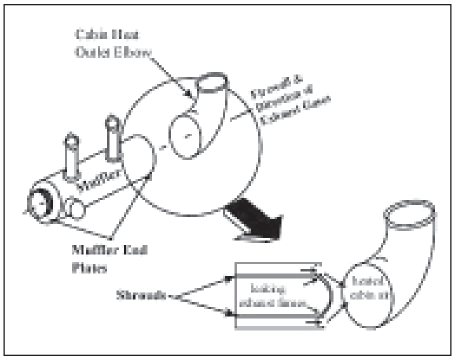
A survival factors/cabin safety issue identified during the investigation of this accident was the lack of training for flight attendants and flight crewmembers to recognize the signs of an overpressurized airplane and the dangers of opening an emergency exit door while the cabin is pressurized. Several of the flight attendants reported after the accident that they did not know why their doors would not open during the emergency evacuation.

During the evacuation, the flight attendant at the 4L exit had trouble opening her door and said she "could not believe this was happening, this had never been covered in training." The investigation found that the flight crewmembers did not know that the airplane was overpressurized when they activated the emergency evacuation alarm, and the flight attendants did not know that the airplane was overpressurized when they responded to the evacuation signal. The American Airlines flight crew and flight attendant training manuals and programs did not provide any information about recognizing the signs of an overpressurized airplane.

Two other similar explosive door accidents involving another A300 and an A330 airplane have occurred since the American Airlines accident. In the first of these, a flight attendant was killed and another flight attendant was seriously injured during a normal deplaning of TunisAir Fight TARB631 at the Djerba Airport, in Djerba, Tunisia, on Oct. 20, 2001. While an air stair was being positioned at the A300-605R Airbus airplane, a flight attendant attempted to open the 2L door. Excessive cabin pressure caused the door to burst open, and the flight attendant who opened the door was ejected, sustaining serious injuries. In addition, a flight attendant who was standing near the flight attendant who opened the door was also ejected from the airplane and killed.

The A330 accident occurred at the Airbus production facility in Toulouse, France. According to Airbus, a company mechanic was killed when he opened the emergency exit door during a production pressurization test on an Airbus A330. According to Airbus, the fatally injured mechanic joined Airbus in 1991 and had performed this pressurization test many other times prior to the accident.

On May 8, 2001, the Safety Board issued Safety Recommendations A-01-16 through 22 to the FAA regarding infor-



mation contained in the Airbus Industrie A300-600 operating manual and checklists, and A300-600 operators' operating manuals, checklists, and training programs. Safety issues included the adequacy of information on depressurization of the airplane when the pressurization system is being operated in the manual mode; the need for the flight crew to verify that the cabin differential pressure is 0 pounds per square inch (psi) before signaling the flight attendants to begin an emergency evacuation; and the need for the flight crew to verify that the cabin differential pressure is 0 psi before permitting the flight attendants or gate agents to open the cabin doors.

The Safety Board issued additional recommendations to the FAA on Aug. 2, 2002, relating to the explosive opening of the A300 emergency exit door. Recommendations A-02-20 through 23 were issued to the FAA as follows:

- Require that all newly certificated transport-category airplanes have a system for each emergency exit door to relieve pressure so that they can only be opened on the ground after a safe differential pressure level is attained. (A-02-20)
- For those transport-category airplane emergency exit doors that can be opened on the ground when the airplane is overpressurized, require air carriers to provide specific warnings near the emergency exit doors (such as lights, placards, or other indications) that clearly identify the danger of opening the emergency exit doors when the airplane is overpressurized. (A-02-21)
- Review all air carriers' flight and cabin crew training manuals and programs and require revisions, if necessary, to ensure that they contain information about the signs of an overpressurized airplane on the ground and the dangers of opening emergency exit doors while the airplane is overpressurized. (A-02-22)
- Require that cabin crew training manuals and programs contain procedures to follow during an emergency evacuation when the airplane is overpressurized. (A-02-23)

Incapacitation

Last year, two investigators from the Safety Board's Southwest and Southeast Regional Offices proposed two safety recommendation related to Cessna single-engine airplanes in which muffler erosion resulted in the pilot and passengers experiencing carbon monoxide poisoning. A research of the NTSB database and FAA Service Difficulty Reporting System (SDR) found other single-engine airplanes with eroded mufflers in which the pilots and passengers were incapacitated or were tested positive for carbon monoxide poisoning.

One of the cases involved a Piper Dakota, U.S. registration N8263Y, accident on Friday, Jan. 17, 1997. The instrument-rated pilot and his 71-year-old mother had departed Farmingdale Airport on New York's Long Island at 11:15 a.m. on a VFR flight to Saranac Lake, N.Y., about 2 hours' flying time to the north. Less than a half-hour into the flight, the pilot passed out. Thirty-six minutes into the flight, the passenger (who was herself a low-time private pilot) radioed Boston Center and told the controller that the pilot was unresponsive and vomiting and that they were in trouble. After determining that the passenger was pilot-rated, the controller spent the next 20 minutes trying to talk her down to a landing at Bridgeport, Conn. An Air National Guard helicopter joined up with the aircraft and participated in the talk-down attempt.

Forty-five minutes into the flight, the woman reported that she, too, was getting tired and nauseated, and was unable to awaken the pilot. Shortly thereafter, the airplane turned north and started climbing. The woman stopped responding to radio calls. The aircraft gradually climbed to 8,800 feet, and the helicopter lost sight of the airplane. About 2 hours into the flight, the airplane descended out of the clouds and the helicopter established visual contact, reporting that the cabin appeared to be full of smoke and that no one was visible through the windows. Not long afterwards, the Dakota started descending rapidly and crashed into the woods near Lake Winnipesaukee, N.H. Both occupants were killed.

Toxicological tests of the pilot's and passenger's blood found the pilot's blood had a carboxy hemoglobin (CO) saturation of 43 percent, and the passenger's measured 69 percent. NTSB metallurgists determined that the muffler contained a large crack and an irregular hole, both of which had been leaking exhaust gas for some time. The Safety Board determined the probable cause of this accident was "an exhaust gas leak, due to inadequate maintenance, which resulted in CO poisoning and incapacitation of the pilot."

A search of the Safety Board's database for accidents or incidents involving CO poisoning from 1964 to the present found 50 accidents or incidents, which resulted in 77 fatalities and 5 serious injuries. The federal aviation regulations indicate that exposure to CO at levels greater than 50 parts per million can cause oxygen deficiency. According to the U.S. Army's Aircraft Crash Survival Design Guide, symptoms of CO poisoning may include shortness of breath, headache, fatigue, nausea, disorientation, unconsciousness, and respiratory failure, depending on CO concentration levels and duration of exposure.

Because the investigation of these accidents found that CO poisoning in the cabin was caused by erosion of the airplane's muffler, the Safety Board's accident database was reviewed to determine how many accidents and incidents had occurred where erosion of the muffler had resulted in CO poisoning. The search found 123 accidents and incidents between 1964 and the present that involved eroded muffler end plates that allowed carbon monoxide fumes to enter the cabins in single-engine airplanes (Cessna, Piper, Beech, Aero Commander, Luscombe, Navion, and Aeronca).

Also, the FAA's SDR system included 232 reports of cracked or leaking mufflers on single-engine airplanes between 1974 and 2001. Many of the SDRs indicated that visual inspection of the exhaust system did not, or would not, have detected cracks. For example, an entry on a Cessna 182 SDR, dated Oct. 15, 1998, stated, "performed pressure test and found a 1-inch crack along edge of weld attaching flange to forward end plates. Cracks cannot be visually seen unless muffler is removed. This airplane had gone through an annual inspection just 14.7 hours before the defect was found."

Many of the leaking mufflers that allowed carbon monoxide to enter the cabin occurred within a short time following the last annual inspection. A review of the recommended inspection procedures in the Cessna Model 150, 152, R172, 180, and 185 service manuals indicated a visual inspection of the muffler's intake and exhaust system was recommended every 100 hours of operation. The manuals also recommended removing the muffler and subjecting it to a pressure test under water to thoroughly check for leaks. Although these procedures would most likely identify any cracks or defects in the muffler, there is no requirement to follow the inspection procedures recommended in the Cessna service manuals.

The Hilo Fire Department identified three survival factors issues: 1) Evacuation, 2) Passengers inflating their life vests before they evacuate the airplane, and 3) Passengers donning their life vests over their headphones.

In 1971, the FAA issued Airworthiness Directive (AD) 71-09-07, which addressed a similar issue on Cessna turbocharged airplanes (Models TU206, TP206, T207, and T210 through T210N). The AD required the exhaust manifold in the cabin heat exchanger area be pressure tested for cracks within the next 25 hours of time in service (TIS) and thereafter at intervals not to exceed 50 hours TIS since the last inspection. A recent search of the Safety Board's accident database found no incidents or accidents involving muffler failures on Cessna T206, T207, or T210 airplanes.

There have been five other ADs (issued between 1962 and 1980 and applicable to certain single-engine airplane models) that require visual inspection and pressure testing of mufflers. However, frequency, testing intervals, and pressure values vary among these ADs.

Ditching

On Aug. 25, 2000, a Piper PA-31-350 operated by Big Island Air, Inc. (BIA), as a sightseeing flight, Number BI57, Registration N923BA, lost power to its right engine and ditched into Hilo Bay while attempting an emergency landing at Hilo International Airport, Hilo, Hawaii. One passenger was killed, and the pilot and seven passengers sustained minor injuries during their evacuation from the sinking airplane. The accident occurred during visual meteorological conditions, and the flight had originated in Kailua-Kona, Hawaii. BI57 was enroute to the Hilo area with a return to Kona, Hawaii.

Preliminary findings found that the rubber seal had extruded between the right engine oil filter and the engine accessory section, which caused excessive oil leakage from the right engine. The examination of the wreckage, and interview of the pilot, the passengers, representatives of BIA, and the firefighters and scuba divers from the Hilo Fire Department identified three survival factors issues:
1) Evacuation,
2) Passengers inflating their life vests before they evacuate the airplane, and
3) Passengers donning their life vests over their headphones.

1) *Evacuation*

The pilot said that he informed passengers to don their life vests and assume the crash position before he ditched the airplane. He said that the airplane's airspeed was about 75 knots and that the airplane's stall warning alarm sounded as the airplane's fuselage skimmed across the water. Passengers said that the landing seemed hard and they experienced bouncing during the landing; however, examination of the airplane cabin after it was recovered from Hilo Bay found that the cabin interior and furnishings remained intact except for the damage sustained by the aircraft during its recovery from the Bay. Also, Hilo Fire Department scuba divers reported that the airplane cabin was intact before the airplane was recovered.

The occupants did not sustain injuries that would have prevented them from escaping, and all but one occupant successfully evacuated the sinking airplane. The most hazardous survivability

aspect was the rapid submersion of the airplane. One passenger said that the airplane sank within 1 minute, and another passenger reported that it was completely under water as she exited through the forward exit. Some passengers also reported that the airplane leaned to the right as it sank. When a passenger attempted to open the right overwing exit hatch, the water pressure against the hatch was so great that the passenger was unable to open the hatch.

The female passenger who was in seat number 4 did not survive the accident. Her cause of death was asphyxia due to salt water drowning. Her husband said that she could not swim, and no one reported seeing her making an escape attempt. A passenger who quickly evacuated the sinking airplane saw her sitting in her seat with her seat belt fastened and her life vest inflated as the airplane filled with water and sank.

2) *Life vests inflated before evacuation*

The pilot stated that during the preflight briefing he instructed the passengers how to automatically (by pulling a chord that fires a pneumatic cartridge to inflate the vest) and manually (by blowing into an inflation tube in the vest) inflate the life vests, and only to inflate the life vests after they depart the airplane. Several passengers said that they inflated their life vests before evacuating the airplane. The passenger who occupied seat number 7 said that she inflated her life vest before she approached the front door of the airplane. She said that the water pressure entering the airplane was "enormous" and that by the time she reached the front exit, it was under water. She said she got stuck in the doorway while trying to exit the sinking airplane but managed to wiggle free and successfully exit the rapidly sinking airplane. Hilo Fire Department scuba divers found the body of the women in seat 4 floating inside the forward cabin with her life vest partially inflated.

3) *Life vests donned over headphones*

The pilot briefed the passengers about how to don their life vests before the flight. However, he did not inform passengers to first remove their headphones before putting them on. During the examination of the wreckage, three of the passenger headphones were found plugged into the audio outlets at seat numbers 4, 6, and 8, and a life vest intertwined at the end of the headsets. The passenger who occupied seat number 3 said that it felt like something was "holding him down" as he was trying to get out of the airplane, and the passenger who occupied seat number 5 said that after the airplane hit the water her husband reached across her and pulled her earphones from the cabin wall because the wire was tangled in her life jacket.

According to *The Aircraft Cabin, Managing the Human Factors* written by Mary and Elwyn Edwards, the safety of passengers is enhanced if they know what to do in an emergency, and individuals perform better if they have received instructions about the use of emergency equipment.

As a result of the investigation of this accident, representatives from BIA informed Safety Board staff that they had revised their pre-flight briefing procedures to include information on the removal of headphones before the donning of a life vest during a ditching emergency.

The Safety Board has identified many types of survival factors issues during its investigation of major aircraft accidents. The NTSB's investigation of the McDonnell Douglas MD-82 runway overrun during landing accident in Little Rock, Ark., on June 1, 1999, generated several recommendations related to emergency response, and provided a detailed description of the survivable aspects of the accident. This accident report and the Survival Factors Factual Report are quite extensive and are available on the NTSB website.

For further information about the National Transportation Safety Board, please log onto www.ntsb.gov. The site includes a wealth of information about transportation accident and incident investigations and NTSB recommendations. ◆

Air Accidents Over Water

(This article was adapted, with permission, from the authors' technical paper entitled Air Accidents Over Water, *presented at the ISASI 2002 Seminar in Taipei, Taiwan, October 2002. The full paper is available on the ISASI website at http://www.isasi.org.—Editor)*

Investigating over water accidents is more complicated than over land accidents because the eye can't see the components and special tools are required to locate them, while different tools are used to recover them.

By John Perry Fish and H. Arnold Carr, American Underwater Search & Survey, Ltd. (CP0131)

Many of the world's major airports are near seaports and harbors or other large bodies of water, and because the oceans cover much of Earth's surface, a significant portion of air travel is over water. There are numerous examples of aeronautical debris being lost in the water environment. Entire aircraft such as SAA 295, KAL 007, TWA 800, and IT 870, lost off Ustica Italy, have been the subject of extensive search-and-recovery operations. Isolated parts of aircraft requiring recovery from the submerged environment include propellers, powerplants, jet engine discs, as well as individual hull components such as the cargo door from United Flight 811, which was recovered from the deep Pacific in 1989.

Investigating accidents that occur over water presents more complications than those occurring over land, because lost components are hidden from the naked eye. Further, special tools are required to locate them, while different tools are used to recover them. Past experiences have provided lessons in dealing with the unique problems of locating and recovering submerged aircraft debris. These apply to both large debris fields and isolated, small aeronautical components.

Many of the lessons learned in the past two decades of search and recovery for aeronautical components have helped investigators succeed in recovering parts from other over water accidents. Examples of this include applying appropriate search methodology and detailed mapping of discrete debris fields versus large-scale survey techniques to locate small isolated parts. Other lessons are more practical. Who, for example, would have predicted that a major technical problem for remotely operated vehicles (ROV) working aircraft wreckage would be the near neutrally buoyant passenger blankets jamming the ROV thrusters (propellers)? Each time, the ROV has to be recovered, cleared, and redeployed (a time-consuming operation when working in deep water).

If a radar return from lost target(s) is available, it is one of the first clues in narrowing the search area for locating components from accidents over water. Radar data on these accidents can be more important than at land sites. When aeronautical components and debris stop falling through the air and impact the water, they disappear and are re-vectored by ocean currents. Heavy materials that in air take on a ballistic feature and travel far down the flightpath now are affected the least by ocean currents and fall in a straighter line to the bottom. Conversely, the lighter material that loses along-track velocity quickly in air is pushed the farthest by the ocean currents before coming to rest on the seabed. Finally, debris not dense enough to sink may be carried great distances from the site by waves and currents. This is one reason that the spread of debris on the seafloor is often very different than that found at land accident sites.

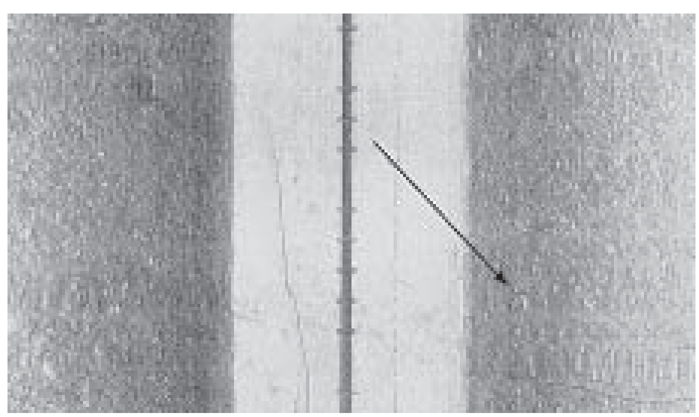


ILLUSTRATION 1: ***The seabed conditions will often dictate search parameters such as tow speeds, range settings, and sonar frequencies. Here, on a rugged volcanic substrate, the fan containment ring from a P&W JT-9-D engine almost blends into the background but is still recognizable.***

About the Authors: John Perry Fish, *left, and* ***H. Arnold Carr*** *each have more than 30 years of working in the oceanographic field and more than 20 years of supporting accident investigations. They have published two widely acclaimed textbooks relating to the search and location of small targets underwater and specifically in their most recent book* Sound Reflections *they have included an entire chapter dealing with locating and recovering aeronautical components in support of air safety investigations.*

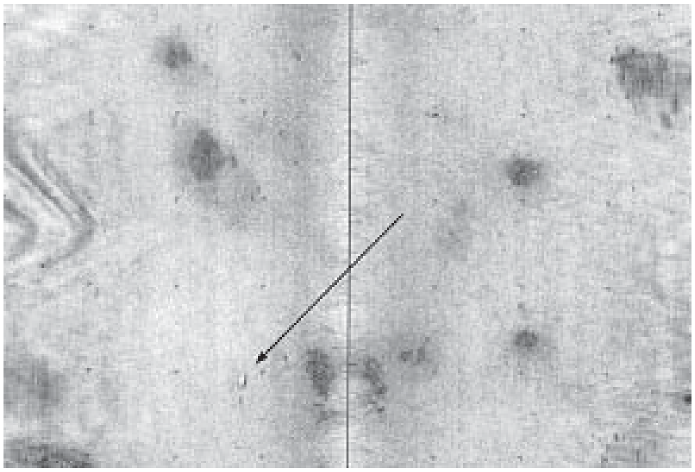


ILLUSTRATION 2. ***When the pilot ejected from an A-4 Skyhawk, the canopy fell into the sea over 1 mile up the flightpath. Although geological features are present, the canopy came to rest on an unobstructed region of seabed.***

Search/Survey operations

Search, as contrasted with survey operations, implies that there is a known object at an unknown location requiring rapid seabed coverage and detailed analysis of targets located. Typically, target verification requires different tools than those used for search. Conversely, survey implies that there is a known location without any knowledge of what may be found within this region. Both search and survey play key roles in locating targets from accidents over water.

Equipment—Tools used in both of these operations vary, depending upon the size and type of debris being sought, but invariably involve the use of sonar for both search operations and wide area survey. Optical systems have been used in the past for search, but such systems have significant limitations. Laser line scan systems are complex instruments to operate and are only applicable at specific altitudes above the seafloor. Their range is limited due to the excessive absorption of light energy in water. Data acquired by laser line scan systems are easily degraded by heave. Low light and color video systems are used only for close inspection after objects have been located with longer-range search systems. On the other hand, sonar (SOund Navagation And Ranging) has good in-water transmission characteristics, and its energy can be formed into the sophisticated beam shapes necessary for imaging. Of all the oceanographic sonar systems used for both search and survey operations, side scan has proven to be the most efficient in terms of area coverage and resulting data quality. Swath or bathymetric sonar systems, which are commonly used for measuring water depth while providing some imaging capability, are not designed to detect small targets at great distances.

Investigating accidents that occur over water presents more complications than those occurring over land, because lost components are hidden from the naked eye.

In search operations for large targets (from the size of a large powerplant up to a main debris field from a large aircraft) medium frequency (100-200 kHz) pulsed or chirp (linear swept FM) sonar is a commonly applied tool. Smaller targets, such as an 0.5 m rudder hinge, jet engine compressor, or turbine discs or a portion of propeller blades, require higher frequency systems such as 500 kHz to 1.2 MHz imaging sonar.

Initial operations—In investigations where entire aircraft are lost, using radar data, hindcasting of flotsam, and long-range survey methodology helps to locate main debris fields quickly. This is often done during early, less-organized survey operations because of the urgent nature of the work and the time it takes to mobilize experienced survey personnel and equipment to the site. After major debris fields are located, the next step is to have the fields surveyed or "mapped" in a high-resolution mode.

This mapping process provides the investigator with a detailed plot of the undisturbed site where components of interest can be identified and pinpointed. Thus, detailed imagery of an undisturbed site forms a "base line map," which allows investigators to effectively supply directives for the recovery operation.

In many cases, such as at TWA 800, several debris fields may be located. Each debris field needs to be surveyed in a "mapped" high-resolution mode so that all will have a base line map. Often, regions of seabed containing significant amounts of debris are assigned "identities." These may be alphanumeric or color-coded such as those at both the TWA site and the land site of Pan Am 103. Once the main debris locations are base line mapped, the survey can then begin the much more time-consuming secondary task of locating potential debris in areas less likely to hold aeronautical components. This process is known as *wide area survey* as opposed to the *detailed mapping* survey applied to the main debris fields early on. It is here that debris recognition in remote sensing data and data interpretation become important.

Wide area survey data interpretation—Targets in remote sensing data, particularly sonar data, take many forms, and the

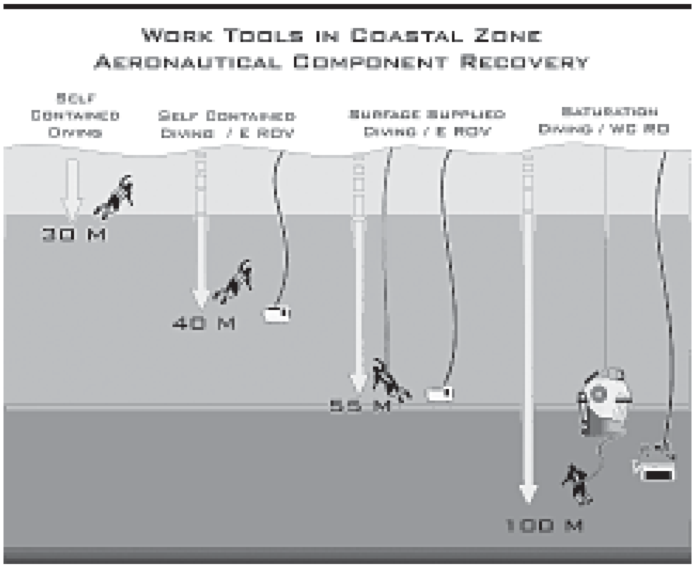


ILLUSTRATION 3: ***In coastal zone environments, divers or a combination of divers and equipment can accomplish work in aeronautical part recovery. In shallow depths, electrically power ROVs can be used. In deeper water, hydraulic work-class vehicles are typically required.***

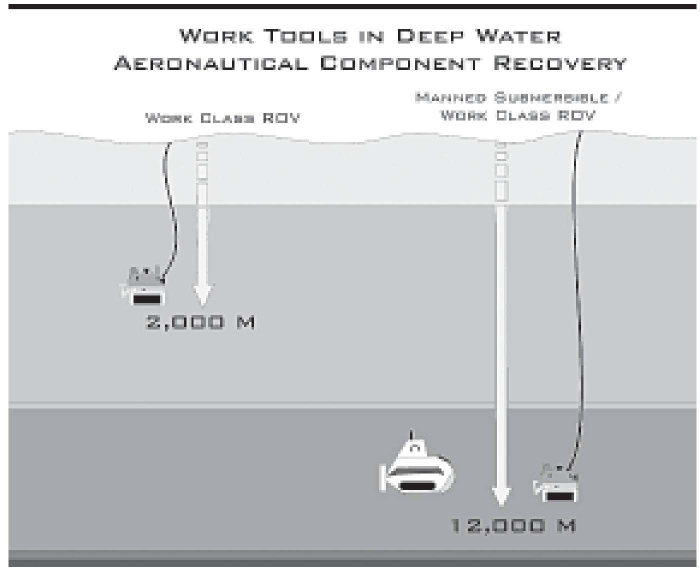


ILLUSTRATION 4: ***In deep water exceeding hundreds of meters, equipment is always required for underwater work. Although manned submersibles have been used occasionally, deep-water ROV systems are often a tool of choice for part recovery.***

data must be interpreted accurately. Indeed there have been a number of textbooks written on the subject of sonar data interpretation, the most recent of which is more than 270 pages in length.

Accurate interpretation is required because other objects typically surround aeronautical debris in the submerged environment. These objects include naturally occurring entities such as rock outcroppings, rugged seabed, bottom scours caused by currents, and patches of highly reflective material such as regions of boulders. Other targets in the region might be man-made such as shipwrecks (both old and new) and abandoned or "ghost" fishing gear. All of these objects and structures have the potential for confounding the data interpreter.

Another complication in identifying targets in search data is the substrate or makeup of the seabed itself. Rough, cobble covered, or a volcanic substrate can mask key targets of interest during search operations. Illustration 1 is a sonar dataset of a fan containment ring from a P&W JT-9-D jet engine. Although it is recognizable in the image, if it were much smaller it would likely blend into the background of the seabed. On a smooth sand or mud bottom, even much smaller objects normally stand out more clearly in data. Illustration 2 shows the canopy of an A-4 Skyhawk on a clean seabed of sand. Although there are numerous geological outcrops in the region, the fact that the canopy happened to fall in an unobstructed region makes it significantly more recognizable as an anomaly.

The data interpreter experienced in identifying aeronautical debris uses a natural neural network in analysis of targets. By looking at the target's level of acoustic energy return, its size and shape, and the structure of its shadow—if present, the interpreter compares these features with those from the same target seen elsewhere in the data. A determination can then be made, based upon experience of viewing data from other known aeronautical debris fields, whether it has the potential to be a target of interest.

The wide area survey for aeronautical debris generates data that might be used if all parts of the aircraft are required for the investigation; thus, the survey cannot overlook any target that has even a remote possibility of being a target of interest. A noteworthy point is that the parts located away from the main debris fields are likely to be small and might resemble other objects such as abandoned or fixed fishing equipment and occasionally certain forms of geophysical features. These targets cannot be dismissed if the goal is to maximize the part location and recovery process. In this manner, a database of potential targets is constructed and refined through review, typically at a shore-based data processing facility.

In some past investigations, the information from the wide area surveys was not required or used. When the causal factors are determined from information extracted from data recorders or wreckage recovered from main debris fields, optical examination of small parts far afield may not be necessary. However, if causal factors are not determined from wreckage recovered immediately, examining and recovering the targets located in the wide area search become important, and the survey data become crucial.

Recovery operations

The methodologies used in the recovery of submerged aeronautical debris vary widely with several factors influencing each. The depth of the water is a major determining factor in what tools and methods are used. Also the prevailing weather, time of year, and the distance to the nearest major port will all affect the type of system employed in debris recovery.

Vessels—For major wreckage recovery, heavy lift is almost always required. Vessels supplying heavy lift equipment, which is often in the form of stiff-legged or "knuckle" booms, are best if they are dynamically positioned. Unpowered barges that must anchor pose the clear and oft-demonstrated danger of damaging aircraft debris. If anchored barges must be used, personnel familiar with the position of the aircraft components must closely monitor anchor placement. Further complicating the process, the deeper the water is, the less control barge operators have over where their anchors end up.

Conversely, dynamically positioned vessels do not rely on anchors, but rather vessel-mounted thrusters for positioning. Computer systems that are connected to the engines and drive systems, GPS receivers, and acoustic subsea positioning systems maintain the desired position of the ship. Even in high winds or strong currents, the ship's position is accurately maintained. In these cases, there is no danger of dropping heavy anchors into the debris field or dragging them through it.

Underwater work—When recovering debris, digging holes in the seabed by using a "grab" system is to be avoided when possible. The preferred method is to use "sling and pick" operations to minimize post-accident changes in the recovered debris. The two most recent B-747 accidents over water in 1996 and 2002 both used this method of recovering wreckage. To use this method, underwater work must be performed to rig parts for lift.

In the shallow waters of coastal regions, divers can effectively perform the task. These divers should be experienced in rigging practices and, if the accident is recent, be experienced in body recovery techniques. Deeper water requires the employment of specialized diving techniques as well as robotic support. In depths deeper than about 300 meters, most investigations have relied upon robotics alone to recover crucial debris such as data recorders, and to rig larger parts for recovery. In the past, on a few occasions, such as the recovery of parts from United 811, manned submersibles have been used to recover crucial debris in very deep water. However, this is unusual particularly with the recent advent of ROV systems with deep-water capability.

The table below and Illustrations 3 and 4 show the relationship between various depths and the underwater work tools used.

Depth Range	**Recovery Tools**
0-30 m	Self-Contained Divers
30–40 m	Self-Contained Divers/ROV
40–55 m	Surface-Supplied Divers/ROV
55–100 m	Saturation Diving/ROV
100–2,000 m	ROV
2,000–12,000 m	ROV/Manned Submersible

Remotely operated vehicle systems used in deep water are hydraulically powered, have multifunction mechanical arms, multiple color video cameras, an acoustic positioning system, and a scanning sonar. It is the scanning sonar (different from side scan sonar) that allows the ROV to acquire targets on the seafloor. If the work is being performed on a major debris field, positioning systems and the video cameras play a large part in the navigation of the vehicle.

It has been found that using appropriate mapping and survey techniques can help to direct recovery operations in a timely and effective manner.

When the target is a small, isolated component, the scanning sonar becomes an important tool in that it can sweep in a circle of 100 meters or more to detect targets of interest. Using the sonar readout on the surface ship, the ROV pilot can then navigate to specific targets as long as they have some relief off the bottom. Complications can arise if the parts to be located lie flat on the bottom and the scanning sonar does not detect them. In this case, the ROV video systems are used in a "micro-survey" to locate the parts in the region. This is a time-consuming, but sometimes necessary, task.

Transportation of recovered debris—Crucial small debris recovered, such as data recorders, can be brought from the work site to shore via helicopter or by small high-speed boat when the site is in coastal waters. In deeper ocean waters, it may be necessary for the recovery vessel to transit to a location where a pickup can be made, even for small debris. For larger, more bulky debris, alternate platforms can be used to receive the recovered components. If the recovery vessel has excessive deck space, components can be placed there. If not, a secondary vessel can receive the debris. Motorized barges, for instance, can take deck loads of debris to shore for examination. In the case of EgyptAir 990, large steel containers placed on deck were used to prevent the loss of any crucial aeronautical components.

At the site of the TWA 800 accident, motorized barges were used to transport large debris. Later in the investigation, wide area search was used to detect very small targets. Because the water was relatively shallow, numerous small boats with divers were deployed to recover the smaller debris, which was transported to a larger vessel for delivery ashore via helicopter.

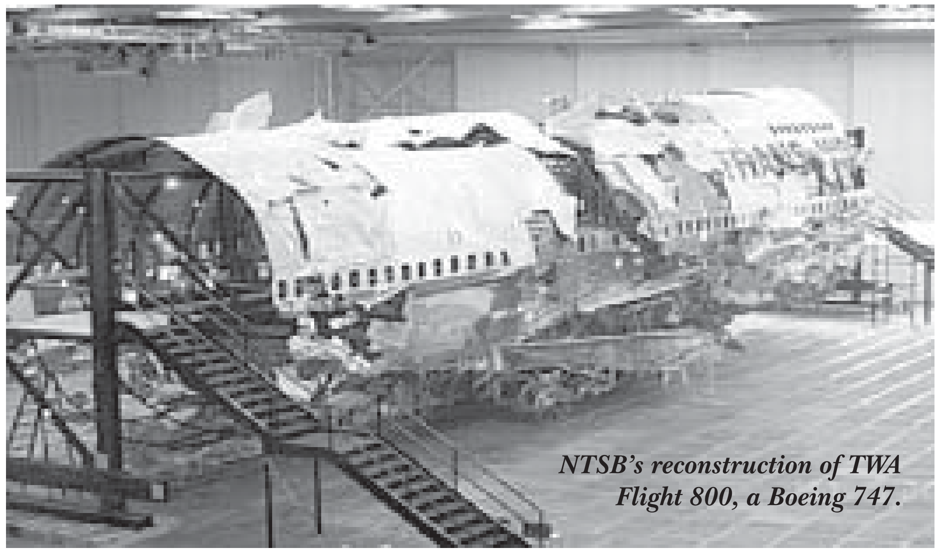
Even though aircraft components can be hidden in the submerged environment after accidents over water, experience has shown that applying proven methodologies and equipment allow the recovery of targets of interest in both shallow and deep water. Different environments require different tools to accomplish this, but it has been found that using appropriate mapping and survey techniques can help to direct recovery operations in a timely and effective manner. ◆

(This article was adapted, with permission, from the author's technical paper entitled Using Processes Learned in Accident Investigations to Systemically Train Investigators, *presented at the ISASI 2002 Seminar in Taipei, Taiwan, October 2002. The full paper is available on the ISASI website at http://www.isasi.org. The views expressed in this article are those of the author and not necessarily the views of the NTSB.—Editor)*

Sharing the Knowledge of EXPERIENCE

The reconstruction of TWA's Flight 800, a Boeing 747, moved NTSB to create a way to transfer some of the lessons learned in that effort to future generations of investigators.

By Keith McGuire (M02416), Northwest Regional Director, NTSB



NTSB's reconstruction of TWA Flight 800, a Boeing 747.

As aircraft accident investigators, we frequently don't do a good job of sharing information and techniques within our investigative community. It is commonly acknowledged that aircraft accident investigators need to learn from other investigators; however, there is still a lack of information available on the professional level after an accident occurs. Because of the high interest from the general public, there is frequently a lot of information available in the press, but it lacks the detail, and perhaps even the basic accuracy, that is necessary for professional investigators. The ideal way to communicate lessons learned from an investigation is to have the investigators who are doing an investigation discuss it directly with other investigators.

The efforts currently under way in the United States at the National Transportation Safety Board (NTSB) are designed to increase the information available to the staff of the NTSB, other government investigators, and the organizations that are involved in the investigation of aircraft accidents through the creation of an NTSB academy located near Washington, D.C.

The NTSB academy will provide training in several transportation modes, transportation disaster assistance, and engineering topics. The facility will also provide the agency, for the first time, space for research projects and the ability to store large pieces of wreckage for both investigative and instructional purposes. But what is important for members of ISASI is the core curriculum being developed for the aviation accident investigators, and the processes the agency used to determine what it wants investigators to know and how that process will take place.

***About the Author: Keith McGuire** is the Director of the National Transportation Safety Board's Northwest Regional Office. A former pilot with the U.S. Air Force, McGuire has a B.A. in physics, an M.A. in counseling psychology, and has completed the Senior Executive Fellows Program at Harvard University.*

Academy origins

Although the NTSB has provided some basic formal training to its investigators for many years, it was the investigation of TWA 800 that stimulated the discussion of a more-extensive effort to formalize and expand the agency's training. After the agency was forced to spend millions of dollars and thousands of hours to recover and reconstruct the wreckage of the Boeing 747, the discussion began about how to transfer some of the lessons learned in that effort to future generations of investigators. Eventually, after a competitive bidding process, George Washington University was selected to host a facility on its Virginia campus near Dulles Airport that could be used to house the wreckage of TWA 800 and serve as an instructional facility for the agency. The building will provide classroom space, a laboratory (hangar), an outdoor simulations court (bone yard), and space for research. This facility is currently scheduled for completion in August 2003.

A Curriculum Development Committee was established by the agency to look at potential approaches to the training program. This Committee consisted of senior people with backgrounds in investigations, technical issues, university instruction experience, and curriculum development for adult education. One of the first things done was a survey of agency managers and investigators to determine what were the expectations of the managers and what specific skills were necessary for the investigators. The survey was also helpful in determining the time investigators allocated to various activities and what technical training the investigators felt was necessary to better equip them in their job.

The survey results from the investigators were not surprising in that there was a wide range of responses received. The headquarters specialists generally wanted training focused in their particular field of expertise, while the regional investigators were more interested in broad-based training that included a variety of skills. It was interesting to find that, irrespective of their specialty, a high percentage of the investigator's time was spent writing reports.

Eventually, it was decided to provide a basic accident investigation course that would offer a sampling of most of the technical skills used by agency investigators and to address the more specialized training either through advanced workshops or outside training programs. While not all of the subjects of the basic course will have full applicability to every specialist, an understanding of what the other members of the team are doing is still valuable information.

While active NTSB investigators may teach much of the core curriculum, the academy is actively exploring ways to partner with outside organizations and instructors to provide a broader view of accident investigation and to provide technical expertise that doesn't exist within the NTSB. Planners anticipate that other government investigation agencies and individual technical experts will provide a much broader look at accident investigations than has traditionally been available at the agency. The NTSB understands that in order to best train its own investigators, there must be involvement of the international accident investigation community in the training process.

The NTSB academy will provide training in several transportation modes, transportation disaster assistance, and engineering topics.

Core curriculum

(1) Basic aircraft accident investigation

The core curriculum considered so far for aviation has resulted in three possible types of courses. The first step for new employees would be the basic aircraft accident investigation course. The previous basic course was routinely evaluated by the students using a written course critique and by agency staff who sat in on various portions of the course.

However, in order to take a more systematic look at the applicability of this course, an agency-wide group of auditors was selected to attend the course and then provide written feedback. The auditors included a cross-section of investigators in the agency so that both new investigators as well as more-experienced investigators would evaluate the course. The newer investigators were able to evaluate the applicability to less-experienced employees while the more-veteran investigators were also looking at the foundation developed for more difficult accidents. Students from outside the agency were also asked for feedback on the effectiveness of the program in their particular activities.

Out of this work came a revision for the next course to modify some subject matter and expand or initiate other areas. The next prototype course is now almost 3 weeks long and includes material on systems safety and survival factors. The legal and procedural material unique to the NTSB will continue to be placed in the first part of the course so that outside agencies can have the option to skip that section of the training, if so desired.

As the new academy building becomes available, the end of the course may be expanded to include testing of NTSB employees with both written and practical exams. This testing will evaluate the effectiveness of the instruction as well as provide an evaluation of student knowledge that can be used to plan future training. Once the investigators' strengths and weaknesses are identified, a plan can be developed utilizing future training at both the NTSB academy and other programs outside the agency to continue development of their skills.

(2) Advanced workshops

The second element of the aviation training being considered is advanced workshops that will build on the same subjects taught in the basic course. One of the common critiques of the basic aircraft accident investigation course was that it included so much material compressed into the 3 weeks that it is hard for the students to absorb all of the information. The advanced workshops should help in this respect by providing "refresher" training in the various subjects as an investigator's career progresses. If 3 hours were spent on the subject of fire investigations in the basic course, the advanced workshop would involve something like 2-3 days of in-depth instruction and more time in examination of wreckage in the simulations yard.

Workshops on subjects such as fire investigations, human factors, survival factors, aircraft performance, system safety, writing accident investigation reports, witness interviewing, and media relations are currently being developed as potential offerings on a rotating basis.

(3) Technical update workshops

A third element under development is the Technical Update and Current Issues Workshop. This Workshop will be held on a periodic basis to allow all of the agency investigators to gain knowledge from the techniques being learned on current investigations. This Workshop will be very interactive and also include the sharing of techniques that didn't work, so that multiple investigators won't make the same mistakes over and over again.

With that core curriculum, the NTSB academy will provide a valuable source of information for aircraft accident investigators directly involved in the accident investigation process. The Academy will use current investigators, technical experts from outside the agency, and other accident investigation organizations to provide the most up-to-date information possible to all investigators. This service will improve aircraft accident investigations and thus aircraft safety throughout the world. [Tutorial programs associated with ISASI 2003 scheduled for August in Washington, D.C., will be conducted at the new NTSB academy]. ◆

ISASI 2003 Prepares Grand Program

Program preparations for ISASI 2003, the Society's 34th annual air safety seminar, to be held in the Washington, D.C., area, have reached the final stages. The seminar brochure has been mailed and should be in the hands of all ISASI members, according to seminar co-chairs Victoria Anderson and Nora Marshall.

In addition, the very informative seminar website, www.isasi2003.com, is in full operation. The site is user friendly and filled with pertinent information about the seminar; hotel registration and accommodations; public and private transportation availability, including reservation methods; and city visitor information with access to visitor kits.

As reported earlier, ISASI 2003, carrying the theme "From the Wright Brothers to the Right Solutions, 100 Years Identifying Safety Deficiencies and Solutions," will be held at the Crystal Gateway Marriott Hotel, in Arlington, Va. The hotel is located 2 miles from Ronald Reagan National Airport, and 5 minutes from downtown Washington, D.C., and the Smithsonian Institution. Because of the hotel's close proximity to the city, it is accessible from any of the three nearby airports: Reagan National Airport, Baltimore-Washington International Airport, and Dulles International Airport.

The hotel provides access to courtesy transportation from Reagan National (DCA) via telephones located in the baggage claims areas. A commercial "Super Shuttle" service operates from Baltimore-Washington (BWI) and Dulles (IAD) on a 24/7 basis and can be reached by calling 1-800-258-3826, or on the web at www.supershuttle.com 24 hours ahead of arrival for reservations; flight number and arrival time will be needed. Without reservations, detailed instructions on how to locate the Super Shuttle at airport boarding points are available on the ISASI 2003 website. To find efficient means of travel after arrival, full details on using the public Metro subway transportation system are also described on appropriate links connected to the website.

The Crystal Gateway Marriott Hotel is providing accommodations at a basic rate of $139 per day for single or double occupancy, $159 for triple occupancy, and $179 for quadruple occupancy. Seminar attendees should make reservations directly with the hotel and are encouraged to make them as early as possible to take advantage of the reduced hotel rate. When registering by phone, attendees should identify themselves as ISASI 2003 participants. To make phone reservations, call 1-800-288-9290 (toll-free for the United States and Canada only) or 703-920-3230. Reservations may also be made from a link on the ISASI 2003 website.

Seminar registration

Registration fees (in U.S. dollars) are as follows: The seminar fee for ISASI members is $495 for registration prior to July 7, and $545 after that date. The accompanying companion fee is $375 and $425, respectively. The seminar fee for non-ISASI members is $545 before July 7, and $595 after that date. The post-seminar tour fee is $104 and $129, respectively. The student registration fee is $400, and day passes are available for $175 per day. The tutorial registration fee is $85.

The registration desk, in the foyer area near the main ballroom of the Crystal Gateway Marriott Hotel, will be open Sunday, August 24 from 11:00 a.m. to 7:00 p.m. and will reopen at 7:00 a.m. on Monday, August 25. Please note that registration will involve photo identification badges for all delegates and companions to facilitate security arrangements. The personalized badges will enable all delegates and companions to be recognized for admission at each program event during ISASI 2003

Technical program

At press time, the Technical Program Committee is right on schedule in selecting papers for ISASI 2003, according to Tom McCarthy, Committee chairman. He said that the technical program will focus on "air safety through investigation" and will feature the latest in investigative techniques/technology and historical innovations to improve overall international investigative performance.

The Committee reports that 25 potential presenters submitted indications of interest, which were acknowledged, and an invitation to submit an abstract was extended.

Completed abstracts, due April 1, are being received and will be reviewed when the Committee meets to select papers for presentation. Selected papers are due June 1.

The subject matter of the indications of interest show a wide spectrum of subjects, including fire and underwater investigative techniques, cabin safety, electromagnetic environmental effects, computer tomography, recent accident reviews, aircraft reconstruction, flight recorders, and aviation medicine, all with an emphasis on history and useful information for the air safety investigator. The Committee plans to have session keynote speakers during the seminar who will provide the attendee with a candid, inside look into aircraft accident investigation management. The subject matter of selected papers will be placed on the ISASI 2003 website when available.

Subject selection is based, in part, on material that is readily helpful to the

ISASI 2003 Corporate Sponsorhip

Because of the vital support that sponsorship provides to the seminar, the committee is actively recruiting corporate sponsors for the 2003 seminar. There are four levels of sponsorship, each of which includes benefits of recognition and complimentary registration. Sponsorship levels are Platinum ($20,000), Gold ($10,000), Silver ($5,000), and Bronze ($2,500).

In addition to these levels of sponsorship, Ron Schleede, sponsorship chair, noted, "We have also created a unique 'first flight' centennial sponsorship level called the *'Wright Sponsor.'* Any donation to ISASI 2003 between $100 and $2,499 will be recognized as a *Wright Sponsor* and listed in the seminar *Proceedings* and on the ISASI 2003 website. Donations to ISASI are tax deductible." Donations should be sent to ISASI in care of Ann Schull, ISASI office manager, at 107 E. Holly Avenue, Suite 11, Sterling, VA 20164. (Telephone: 703-430-9668; Fax: 703-430-4970; E-mail: ISASI@erols.com). Checks should be made out to "ISASI 2003."

Despite the severe economic situation regarding the world's civil aviation industry, several ISASI corporate members have again committed to assisting this year. They include Airbus Industries, the Air Line Pilots Association, Air Tran Airways, Boeing, Honeywell Aerospace, Pratt & Whitney, and Southwest Airlines. Other corporate and individual members have committed to be *Wright Sponsors.* Nonetheless, additional support would be sincerely appreciated.

"Remarkably," noted Schleede, "we have received a commitment from jetBlue Airways at the Platinum level. Because of this significant support, the ISASI 2003 Committee will be able to include a special "jetBlue Fun Night" event for which jetBlue Airways will be recognized as the sole sponsor." ◆

investigator to improve the technical, operational, and management of investigative activities. The Committee consists of ISASI members Joe Reynolds, FTI; Keith Hagy, ALPA; Bob Matthews, FAA; and Erin Gormley, NTSB. Factors these members will consider in evaluating abstracts and final papers include

- related to seminar theme.
- useful to membership in aircraft accident investigation process.
- doable—does the paper present information that can be put into being by the membership.
- meet legal and ethical standards.
- constructive criticism. Criticisms of organizations, agencies, or members that are not common knowledge and provable will not be allowed.
- not related to litigation.
- non-offensive to other members.
- technical adequacy.
- original material not previously presented.

Tutorial programming

The tutorial program will be held on Monday, August 25, at the Safety Board's new academy in Ashburn, Va. Two tutorials will be offered, and attendees can select either fire investigation or recorded data. Tutorial instructors will be from the FAA's Technical Center and the NTSB's Office of Research and Engineering. A tour of the new NTSB academy will be included for both tutorials.

The fire investigation tutorial will cover two phases of aircraft fire safety: inflight fire prevention and post-crash fire survivability. Accidents and incidents in recent years where fire was a factor in the cause of an accident (e.g., Swissair MD-11 in 1998 and ValuJet DC-9 in 1996) or the consequence of an accident will be reviewed. Past full-scale fire tests in support of accident investigations or related to past accidents will be presented, e.g., the activation of chemical oxygen generators in the ValuJet accident, fuselage burn through and cabin fire/smoke spread in the Manchester B-737 accident of 1985, and ignition and violent burning of a titanium hot bleed air duct in the Jordanian L-1011 accident of 1985.

Moreover, fire safety improvements that provide broad benefits will be presented, e.g., seat fire-blocking layers, low heat/smoke release panels, halon extinguishers, etc., with examples of benefits evidenced in specific accidents or incidents (seat-blocking layers, Delta B-727, Dallas, 1988; halon extinguishers, Delta L-1011, Goose Bay, 1991).

The recorded data tutorial will cover the many valuable sources of data, relating to both commercial and general aviation aircraft, that can provide information during an accident investigation. In addition to traditional flight recorder and radar data, other sources, such as aircraft system computers or displays with non-volatile memory, can be accessed to gain important data relevant to an event. "Once the limitations of the data are understood, the information can be integrated to produce engineering unit data, parameter plots, and graphical animations, which can help in determining the sequence of events leading up to an accident and aid in the overall investigation," notes the program material.

Social activities

The first day of the companion's program includes a tour of Washington, D.C., featuring major monuments and national buildings, Arlington National Cemetery, lunch, and a tour of the fashionable neighborhood of Georgetown with a visit to Dumbarton Oaks. The second day includes a tour and lunch at Marjorie Merriweather Post's Hillwood Museum and gardens. Hillwood is a 25-acre estate in the heart of Washington. The Museum includes a comprehensive collection of 18th- and 19th-century Russian imperial art and collections of 18th-century French decorative arts. The third day of the companion program will be a free day reserved for individual sightseeing and shopping. Registration for the companion's pro-gram includes 2 days of tours (including lunch); three continental breakfasts; Monday evening's Welcome Reception; and the Awards Banquet, which will be held on the last evening of the seminar.

In addition, because of jetBlue Airways' generosity, the ISASI 2003 committee has organized a "jetBlue Fun Night" aboard the Odyssey Cruise ship for Tuesday evening, August 26. This event was not included in the original program announcement because of budget constraints. However, now all registered delegates and companions will be able to attend this buffet dinner cruise. The Odyssey cruise offers exclusive river views of Washington's monuments, the Kennedy Center, and Georgetown. The cruise will include cocktails, a buffet dinner, and dancing to a live band.

A post-seminar Capitol Hill tour will be available, which will include a special tour of the Smithsonian Institution's National Air and Space Museum. The Wright Flyer and other Wright brothers' artifacts will highlight the guided tour. Lunch is included.

Attendees of the seminar are reminded that the weather in the Washington, D.C., area is generally hot and humid during late August. Temperatures during the day average 29 to 31 degrees Centigrade (84.20 to 87.80 F), while cooling to 19 to 21 degrees Centigrade (66.20 to 69.80 F) at night. Thunderstorms can occur at any time but are most frequent during the late afternoon and evening. The Washington area is close to many U.S. historical sites and many other places of interest. Visit www.isasi2003.com for more detailed information about all aspects of the seminar. ◆

Correction

The 2003 annual seminar of the Australian and New Zealand Societies of Air Safety Investigators is scheduled for May 30-June 1 and is still accepting registrations through the online registration website. The website address was reported incorrectly in the last issue. The correct address is: www.ASASI.org. Accommodation requests should be forwarded directly to the Novotel Twin Waters Resort. Contact is Kylie Hatcher, fax 61 7 5448 8064.

Lederer Nominations Sought; Deadline June 30

The ISASI Awards Committee is seeking nominations for the 2003 Jerome F. Lederer Award. For consideration this year, nominations must be received by the end of June.

The purpose of the Jerome F. Lederer Award is to recognize outstanding contributions to technical excellence in accident investigation. The Award is presented each year during ISASI's annual seminar to a recipient who is recognized for positive advancements in the art and science of air safety investigation.

The nomination process allows any member of ISASI to submit a nomination. The nominee may be an individual, a group of individuals, or an organization. The nominee is not required to be an ISASI member. The nomination may be for a single event, a series of events, or a lifetime of achievement. The ISASI Awards Committee considers such traits as duration and persistence, standing among peers, manner and techniques of operating, and, of course, achievements. Once nominated, a nominee is considered for the next 3 years and then dropped from further consideration. After an intervening year, the candidate may be nominated for another 3-year period. Committee Chairman Gale Braden (MO3232) noted that "the nomination letter for the Lederer Award should be limited to a single page."

Chairman Braden replaces Charles Pocock who served on the Committee for many years. Braden, now retired, held positions in airworthiness and passenger safety in FAA's Office of Aviation Safety, served as Human Factors and Survival Factors Group Chairman on the NTSB accident investigation Go-Team, and worked in aviation safety research at FAA's Civil Aeromedical Institute. Early in his career, he worked in aircraft maintenance with the FAA and as a civilian with the U.S. Air Force. A private pilot who operates and maintains his own airplane, he holds an airframe and powerplant mechanic license with inspection authorization privileges.

Chairman Braden said, "The Lederer Award is one of the most significant honors an accident investigator can receive; therefore, considerable care is given in determining the recipient. ISASI members should thoughtfully review associations with professional investigators and submit a nomination when they identify someone who has been outstanding in increasing the technical quality of accident investigation."

Nominations should be mailed or e-mailed to the ISASI office or directly to the Awards Committee Chairman, Gale Braden, 2413 Brixton Road, Edmond, OK 73034 USA; e-mail address, geb@ilinkusa.net. ◆

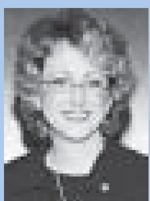
Jerry Lederer Named as 2002 Laurel Legend

Jerome F. Lederer was selected as one of the Laurel Legends for 2002 by U.S.-based magazine *Aviation Week & Space Technology*. He was to be recognized during the 46th Annual Aerospace Laurel ceremony on April 8, 2003, at the Smithsonian Institution's National Air and Space Museum in

NTSB Changes Bring Many New Names

Many changes have occurred within the National Transportation Safety Board (NTSB) in the opening months of 2003. Chief among these is the appointment and confirmation of Ellen G. Engleman as a Member and as the 10th Chairman of the NTSB.

Chairman Engleman was Administrator of the U.S. Department of



Transportation's Research and Special Programs Administration (RSPA) from September 2001 until her NTSB confirmation on March 24. She stepped into the RSPA position 2 weeks after the terrorist attacks on New York City and Washington. Before assuming her post at RSPA, Engleman was Chief Executive Officer of Electricore, Inc., an Indiana-based non-profit consortium for research and development of advanced transportation and energy technologies through federal private/public partnerships. Engleman is a recognized business leader, attorney, and accredited public relations professional.

Chairman Engleman's confirmation brings to a close the position uncertainty that prevailed since Marion Blakey left the NTSB to take over the FAA. That move left Vice-Chairman Carol Carmody in charge. However, with her term about to expire, President Bush, on January 19, appointed Member John Hammerschmidt as NTSB Vice-Chairman, who then became Acting Chairman when Carmody left. On March 21, Hammerschmidt stepped down. In departing, he ended 18 years at the National Transportation Safety Board, the last 12 as a Member of the Board.

Other changes regarding the NTSB include the resignation of Member George Washington Black, who resigned his seat on the Board effective January 28. Black has begun his new position on the agency's staff as Senior Civil Engineer/National Resource Specialist for Highway Investigations.

Two new Members were sworn in during March. Mark V. Rosenker was sworn in on March 24. He has served as Deputy Assistant to the President and Director of the White House Military Office. He later held a temporary assignment at the Transportation Security Administration, where he advised in the rollout of the federal screener program.

Richard F. Healing of Virginia was sworn in on March 28. Before joining the Safety Board, he had been Director of Transportation Safety and Security for the Battelle Memorial Institute since March 2002. Based in Washington, D.C., he had primary responsibility for Battelle's relationship with the Federal Aviation Administration.

Prior to this, he had served since 1985 as Director of Safety and Survivability for the Department of the Navy. During his Navy civilian career, his work focused on aviation safety and emphasized benefits from sharing military safety information with other aviation community participants, especially commercial aviation. ◆

Washington, D.C. Also selected for the honor were Orville Wright and Wilbur Wright, President Jimmy Carter, and William Schneider, Jr.

Jerry will be honored for being the "father of aviation safety" and for his dedication to the ideal that no lives need to be lost unnecessarily while involved in space or flight activities, said the honoring magazine.

Laural Legends include individual who have made contributions to global aerospace over a period of years or who are previous recipients of Aerospace Laurels, which honor individual and teams for making significant contributions to the global field of aerospace during the year in the categories of commercial air transport, aeronautics/propulsion, government/military, electronics, space, or operations. The Aerospace Laurels program also includes the Lifetime Achievement Award. ◆

Dunn, Parker Retain CSASI Positions

Barbara Dunn and Elaine Parker will retain their presents positions in the Canadian Society of Air Safety Investigators, according to Jim Stewart, ballot certifying officer.

In reporting the results to ISASI national headquarters, he said, "I have received only two nominations for CSASI officers for 2003/2004. Barbara Dunn was nominated for President and Elaine Parker nominated for Vice-President. I received no nominations for Secretary Treasurer or Canadian Councillor. Therefore, I declare that Barbara Dunn and Elaine Parker are acclaimed in their current positions." ◆

Reachout Continues; Sets Future Course

The Costa Rica Reachout conducted February 10-14 was hosted by COCESNA (Corporación Centro-Americana de Servicios de Navegación Aérea) and ACSA (Agencia Centro-americana de Seguridad Aeronautica), two organizations that were formed to bring together six Central America countries (Costa Rica, El Salvador, Nicaragua, Belize, Guatemala, and Honduras). COCESNA and ACSA are partially financed by the European Community, Airbus Industrie, the Joint Aviation Authority (JAA), and TACA. The seventh Reachout Workshop was the "featured" program of the Accident/Incident Investigation and Prevention Seminar/Workshop of COCESNA/ACSA.

The 4-day-long Reachout Workshop included 2 days of accident investigation and 2 days of safety management systems and was attended by 70 participants. Countries represented included Belize, Costa Rica, Cuba, El Salvador, Honduras, Guatemala, Mexico, Nicaragua, Panama, and Peru.

Closing ceremonies drew notable dignitaries, including Vice-Ministers and Director Generals of Civil Aviation from the six COCESNA Central American countries. As well, representatives of the European Community, the JAA, Airbus Industrie, and the ICAO offices in Mexico City and Lima attended portions of Reachout and the VIP day.

ISASI Workshop instructors included Caj Frostell and Phil Giles for the 2-day accident investigation session and Jim Stewart for the 2-day safety management system session.

Sponsors for ISASI Reachout included Continental Airlines, Airbus Industrie, Grupo TACA of Costa Rica, ICAO, and the Air Line Pilots Association, International.

Stewart reported that "It is clear that ICAO regional directors see ISASI Reachout as an extremely useful tool to open the door on improving accident investigation and introducing accident prevention concepts and programs. Their support from Montreal headquarters and the regional offices in Mexico City and Lima provided an excellent affirmation of the ISASI Reachout Workshop program."

UPCOMING EVENTS

ISASI 2003 Washington, D.C.—August 26–28.

ISASI 2004 Gold Coast Australia—August 30–September 2.

Flightscape Users Conference, June 4–6, Chateau Laurier Hotel, Ottawa, Ontario, Canada. Conference is designed to instruct about flight data analysis and flight animation. Book hotel rooms through the hotel e-mail www.chateaulaurier.com. Quote Flightscape Users Conference for special rates. Conference contact: Tammy Morgan, e-mail: Tammy.Morgan@flightscape.com; Phone +1(613)225-0070 X231.

21st Annual International System Safety Conference in Ottawa, Ontario, Canada, on August 4–8. The theme of this year's Conference is "Broader Perspectives Focused Solutions." Tutorials and workshops are conducted prior to the technical sessions. Contact www.system-safetyorg/ or the conference website: www.russonacom/ISSC21/.

The International Aviation Fire Protection Association (IAFPA) 4th annual "Aviation Fire Asia 2003" conference October 8–10 in Singapore. Contact website: www.iafpa.org.uk. ◆

Future plans

Having met all existing commitments, Reachout looks to the future, said Stewart. Countries and areas in which future Reachouts may be held include Jamaica, Guatemala, Beijing, Johannesburg, and Central America.

Also in the future will be an offering of an air traffic services (ATS) module in Reachout Workshops. The ISASI ATS Working Group has developed an ATS safety management systems program for the module.

However, before new commitments are made by Reachout, a scheduling pause will be taken. Stewart explained: "Following seven Reachout Workshops, we also believe we need to take a pause to evaluate how we are doing and to develop some standard products, such as certificates, to support future Reachout Workshops." ◆

ATS Working Group Marks Progress

A lot of behind-the-scenes activity has been taking place with the Air Traffic Service Working Group since the Taipei Conference reported newly elected Chairman John Guselli. He said the ATS Working Group is continuing to grow in numbers and is currently focused on the two major objectives of communication and support.

"We have determined that communication between members and stakeholders will be critical to our success," he said. An ATS Working Group listing has been created on the ISASI website (Working Groups). Corey Stephens, webmaster, has assisted in establishing this communications component. The website contains details of current issues, working group priority targets, and a selection of contemporary papers that are drawn from the membership. "We hope to make it a dynamic resource to all members," Guselli said.

A significant and strategic achievement for the Group took place in January in Montreal. Secretary Bert Ruitenberg attended a meeting with the Chief of ICAO ATM and the Executive of the International Federation of Air Traffic Controller Associations (IFATCA). Meeting consensus was that considerable benefit would flow from the alignment of consolidated ICAO, IFATCA, and ISASI ATS Working Group initiatives. In principle, this means that a formal link has been established to explore ATM safety issues at the international level. This safety alliance has received formal support from the top ATS service provider body, the Civil Air Navigation Services Organization (CANSO).

This initiative will expand the base of available investigative resources and further assist in the development of the ISASI Reachout program. Guselli noted, "We believe that we can retain ISASI independence and, at the same time, considerably enhance the capacity for ATS safety investigation in developing States with ICAO and IFATCA."

Contacts for the ATSWG are John Guselli, chairman jguselli@bigpond.net.au; Ladislav Mika, vice-chairman, mika@mdcr.cz; and Bert Ruitenberg, secretary, B_Ruitenberg@compuserve.com. ◆

PNRC Technical Session Outlines 2002 Accidents

The Pacific Northwest Regional Chapter's March technical meeting speaker was Richard Anderson, Boeing Air Safety Investigation. His presentation covered aircraft accidents that occurred during 2002. The meeting was well attended by both members and guests. Anderson has worked extensively with the statistical aspects of accidents and gave an excellent overview of the air carrier accidents that occurred in 2002 and how that compared with previous years. The meeting and presentation, held at the Boeing Longacres facility in Renton, generated considerable discussion from those in attendance.

The PNRC will continue its technical meetings on alternate months throughout 2003, except for August and December. Guests from other regions or individuals interested in aviation safety are always invited to attend any of the Chapter meetings. Details on the exact times and locations for these presentations can be obtained directly from Chapter President Kevin Darcy at kdarcy@safeserv.com or from Leo Rydzewski at leo.j.rydzewski@boeing.com. ◆

AZRC Has Active ERAU Student Section

The Embry-Riddle Aeronautical University Student Section continues to be the most active part of the Arizona Regional Chapter of ISASI. Current student membership has 27 participating, with a big push for all to achieve active International membership. Interest in safety and investigation continues to be very high, and internships with the NTSB, American Airlines, Alaska Airlines, and other safety/investigation organizations remain the most popular among students at the University.

The Student Section meets every 2 weeks on the Prescott Campus and recently elected Marc Rusthoven as the Student Section President. Over the last 3 months, the Section has been very active on the Prescott Campus of ERAU, co-sponsoring an AOPA Air Safety Foundation seminar on collision avoidance and seminars in post-crash survival. The Section coordinated a field trip to the ASU Altitude Chamber for the members and sponsored a presentation by Paul McIntosh—a survivor from the AA1420 Little Rock accident.

The Section is also coordinating and co-sponsoring a permanent memorial for the Columbia astronauts, to be dedicated on the Prescott Campus in the fall. Additionally, members of the Section are assisting Dr. Jim Baker (Prescott Campus faculty member) with construction and installation of a spatial disorientation simulator. They continue to assist Prof. Bill Waldock with maintenance and operation of the Robertson Aircraft Crash Investigation Laboratory. Plans are under way to hold a May meeting of the entire Arizona Chapter on the Prescott Campus. ◆

No Fatal U.S. Air Accidents in 2002

The National Transportation Safety Board in March released preliminary aviation accident statistics for 2002 showing no fatal accidents involving airlines or commuters.

Thirty-four accidents were recorded for scheduled airlines in 2002, all nonfatal. Additionally, there were no fatalities to persons on the ground during the year. In 2001, there were 531 fatalities involving U.S. airlines.

Half of these fatalities resulted from the September 11 hijackings. The 2002 statistics also show a decline in the accident rate on U.S.-scheduled airlines. The 34 accidents involving scheduled airlines resulted in a preliminary accident rate of .337 per 100,000 departures (or 3.37 per million). This represents an 11 percent decrease from the 2001 rate of .379 accidents per 100,000 departures.

While departures decreased for U.S.-scheduled airlines in 2002, nonscheduled 14 CFR 121 and scheduled 14 CFR 135 (fewer than 10 seats) operations increased. The nonscheduled Part 121 operations accident rate increased from 1.248 accidents per 100,000 departures in 2001 to 2.333 in 2002. The accident rate for scheduled Part 135 operators increased from 1.251 per 100,000 departures in 2001 to 1.575 in 2002.

Air taxis reported 58 accidents in 2002, down from 72 in 2001. The accident rate decreased from 2.27 per 100,000 flight hours in 2001 to 1.90 in 2002, and total fatalities decreased from 60 to 33.

The number of general aviation accidents decreased slightly from 1,726 in 2001 to 1,714 in 2002. Fatal accidents increased in 2002 to 343 compared with 325 in 2001. Despite reporting fewer accidents in 2002, the accident rate for general aviation aircraft increased slightly from 6.28 per 100,000 flight hours in 2001 to 6.56 in 2002. ◆

NEW MEMBERS

Corporate
Cavok, International, Inc. (CPO211)
John H. Darbo
Erik C. Fagenberg
ASPA Mexico (CPO212)
Carlos Arroyo
Capt. Carlos Limon
Civil Aviation Safety Authority, Australia (CPO213)
Kim Jones
Al Bridges

Individual
Allen, Jr., James, E., AO4868, Mesa, AZ, USA
Balding, Neville, T., FO4895, Mitcham, SA, Australia
Blessing, Charles, R., AO4872, Indianapolis, IN, USA
Brown, Ian, R., AO4866, Greenwith, SA, Australia
De Santis, Augusto, J., MO4871, San Miguel, Argentina
Dean, Darlene, M., MO4886, Ottawa, ON, Canada
Flannery, John, A., ST4864, Dunlop, ACT, Australia
Gallagher, Michael, R., MO4888, Sacramento, CA, USA
Gallagher, Sheryl, M., FO4894, Canberra, ACT, Australia
Gitimu, Chris, N., MO4870, Dar Es Salaam, Tanzania
Hallman, Christopher, H., AO4876, Newnan, GA, USA
Hancock, John, L., MO4874, Woodland, CA, USA
Hollaway, David Michael, A., FO4882, Houston, TX, USA
Kim, In-Gyu, AO4887, Seoul, South Korea
Limon-Jimenez, Carlos, MO4875, Naucalpan, Mexico
Lukasik, Jason, D., ST4877, Daytona Beach, FL, USA
Lynch, Urban, H.D., AO4891, Long Beach, CA, USA
Mahony, Paul, H., ST4898, Katoomba, NSW, Australia
Malinowski, Edward, F., MO4881, Chicago, IL, USA
Martel, Daniel, ST4889, Geneva, Switzerland
Matley, Joann, E., MO4885, Newport, RI, USA
Mayett, Eric, M., MO4883, Mexico, D.F., Mexico
Michaels, Paris, MO4890, Cape Canaveral, FL, USA
Moran, Samantha, C., ST4897, Bardon, Australia
Nguyen, Thi, H.C., ST4865, Randwick, NSW, Australia
Noble, Jr., George, M., ST4878, St. Augustine, FL, USA
Pelchen, David, P., FO4880, Basel, Switzerland
Pruchnicki, Shawn, A., AO4879, Grove City, OH, USA
Robinson, Mark, MO4869, Crowborough, United Kingdom
Simmonds, Andrew, P., AO4893, Adelaide, SA, Australia
Stoop, John, A., FO4873, Gorinchem, Netherlands
Stott, Doug, J., AO4867, Mildura, Plaza, VIC, Australia
Strow, Joan, H., MO4884, Tulsa, OK, USA
Sweedler, Barry, M., MO4862, Tucson, AZ, USA
Towillo, Maishild, MO4863, Dar-es-Salaam, Tanzania
Winkleblack, Eric, D., MO4892, Albuquerque, NM, USA
Worthington, Grant, M., AO4896, Ashfield, NSW, Australia ◆

NZSASI Newsletter Reports Status

The most recent NZSASI newsletter reports that Peter Williams, Vice-President, is chairman of the committee promoting a newly enacted safety essay prize. "This is a new initiative, which gives any New Zealand citizen the opportunity to enter an essay on a safety topic. A cash prize is coupled with free attendance for the winner at the next ANZSASI seminar, in New Zealand, following the award," said Ron Chippindale, NZSASI President.

Among other items reported in the newsletter were that all 47 members are current on dues, new members have replaced the two members who resigned, and that Selwyn Hetherington, Ivan Strathern, Michael Baker, and Ron Chippindale have qualified for ISASI life member status.

Chippindale also announced that NZSASI has provided speakers for the upcoming ANZSASI meeting and members have been mailed registration forms. He noted that members who attend the next ANZSASI meeting at Mudjimba Beach on the Australian Sunshine Coast, at their own expense, will be refunded up to $500 of the air fare and the *early* registration fee by NZSASI, following attendance. Similar assistance will be given to those NZSASI members attending the ISASI 2003 seminar in Washington, D.C.

The NZSASI Executive records that members have been kept up-to-date with Council decisions and asked for agenda items for the next Council meeting. In addition, an appeal for ideas such as visiting lecturers to invite or area get-together dinners has also been made, as the NZ Executive wants to ensure the NZSASI funds are continually put to good use in the interests of promoting safety investigation.

The Ministry of Transport has not yet released any information on its review of transport accident investigation responsibilities in New Zealand. The original estimate was that the information would be released to NZSASI for comment together with the rail and marine reviews in mid-February 2003. ◆

Cabin Safety Symposium Marks 20-Year Success

The 20th Annual International Aircraft Cabin Safety Symposium held in Los Angeles, Calif., last February featured 22 technical papers, four workshops, and untold opportunities for interaction among the more than 190 attendees. In the written welcome by Peter C. Gardiner, symposium chairman, he lauded those attending over the years for "making this event such a longstanding success."

He especially praised co-founders Barbara Dunn (ISASI MO3276) and Toni Ketchell (ISASI MO2691) for their "vision to provide this enduring forum specifically dedicated to the advancement of aircraft cabin safety."

Among the symposium speakers was Elaine Parker (CSASI) who spoke on bloodborne pathogens. ISASI Office Manager Ann Schull assisted in the registration process and maintained an information booth for the Society. During the event, the booth activity generated three new members for ISASI—Joan Strow, Joann Matley, and Darlene Dean. ◆

ISASI INFORMATION

OFFICERS

President, Frank Del Gandio
Executive Advisor, Richard Stone
Vice-President, Ron Schleede
Secretary, Keith Hagy
Treasurer, Tom McCarthy

COUNCILLORS

United States, Curt Lewis
International, Caj Frostell
Australian, Lindsay Naylor
Canadian, Barbara Dunn
European, Max Saint-Germain
New Zealand, Ron Chippindale

UNITED STATES REGIONAL CHAPTER PRESIDENTS

Arizona, Bill Waldock
Mid-Atlantic, Ron Schleede
Alaska, Craig Beldsoe
Northeast, David W. Graham
Dallas-Ft. Worth, Curt Lewis
Pacific Northwest, Kevin Darcy
Florida, Ben Coleman
Rocky Mountain, Richard L. Perry
Great Lakes, Rodney Schaeffer
San Francisco, Peter Axelrod
Southeastern, Inactive

NATIONAL AND REGIONAL SOCIETY PRESIDENTS

Australian, Kenneth S. Lewis
SESA-France Chap., Vincent Fave
Canadian, Barbara M. Dunn
New Zealand, Ron Chippindale
European, Ken Smart
United States, Curt Lewis
Russian, V. Venkov
Latin American, Marco A. de M. Rocha

CORPORATE MEMBERS

Accident Investigation Board, Finland
Accident Investigation Board/Norway
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Aeronautical & Maritime Research Laboratory
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Austin Digital, Inc.
Australian Transport Safety Bureau
Avianca & SAM Airlines
Aviation Safety Council
Avions de Transport Regional (ATR)
Belgian Air Force, Air Staff Brussels, VSF
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Board of Accident Investigation—Sweden
Boeing Commercial Airplanes
Bombardier Aerospace
Bombardier Aerospace Regional Aircraft/ de Havilland, Inc.
Cathay Pacific Airways Limited
Cavok, International, Inc.
Civil Aviation Safety Authority, Australia
COMAIR, Inc.
Continental Airlines
Continental Express
DCI/Branch AIRCO
Delta Air Lines, Inc.
Directorate of Flight Safety (Canadian Forces)
Directorate of Flying Safety—ADF
Dutch Transport Safety Board
Embry-Riddle Aeronautical University
Emirates Airline
Era Aviation, Inc.
EVA Airways Corporation
Federal Aviation Administration
FedEx Pilots Association
Finnair Oyj
Flightscape, Inc.
FTI Consulting, Inc.
GE Aircraft Engines
Global Aerospace, Inc.
Hall & Associates LLC
Honeywell
Hong Kong Airline Pilots Association
Hong Kong Civil Aviation Department
IFALPA
Independent Pilots Association
Int'l. Assoc. of Mach. & Aerospace Workers
Interstate Aviation Committee
Japan Air System Co., Ltd.
Japanese Aviation Insurance Pool
JetBlue Airways
KLM Royal Dutch Airlines
L-3 Communications Aviation Recorders
Learjet, Inc.
Lufthansa German Airlines
Middle East Airlines
National Aeronautics and Space Administration
National Air Traffic Controllers Assn.
National Business Aviation Association
National Transportation Safety Board
NAV Canada
Northwest Airlines
Pratt & Whitney
Qantas Airways Limited
Republic of Singapore Air Force
Rolls- Royce Corporation
Royal New Zealand Air Force
Sandia National Laboratories
Saudi Arabian Airlines
Scandinavian Airlines
SICOFAA/SPS
Sikorsky Aircraft Corporation
Singapore Airlines, Ltd.
Smith, Anderson, Blount, Dorsett, Mitchell & Jernigan, L.L.P.
SNECMA Moteurs
South African Airways
Southern California Safety Institute
Southwest Airlines Company
SystemWare, Inc.
TAM Brazilian Airlines
The Ministry of Land, Infrastructure, & Transport, AAIC, Japan
Transport Canada Aviation
Transportation Safety Board of Canada
U.K.-Civil Aviation Authority
University of NSW AVIATION
University of Southern California
Volvo Aero Corporation
WestJet ◆

Aviation Safety Education at ERAU

(Who's Who is a brief profile on an ISASI corporate member to enable a more thorough understanding of the organization's role and functions.—Editor)

Within the field of academic aviation safety education, Embry-Riddle Aeronautical University (ERAU) has one of the most comprehensive programs of any university, college, or organization in the world. Over the last 15 years, the university has developed a reputation within government and industry as a "leader" in aviation safety education for undergraduate students and professionals seeking education, training, and certification. The embodiment of ERAU's efforts in aviation safety is the Center for Aerospace Safety Education (CASE), with facilities and personnel at both resident campuses in Daytona Beach, Fla., and Prescott, Ariz., and through the College of Continuing Education worldwide.

The cornerstone of safety education at ERAU is the academic program, which is the organizational responsibility of the College of Aviation on each campus. Currently being offered are a total of nine classes within the Safety (SF) Program at the undergraduate level and 12 at the graduate level. These include Introduction to Aviation Safety, Human Factors, Aircraft Accident Investigation, Mechanical & Structural Factors, Safety Program Management, Aircraft Crash & Emergency Management, Aircraft Crash Survival Analysis, System Safety, and Special Topics in Aviation Safety.

Organizations that have provided co-ops and jobs for ERAU graduates include the NTSB, the FAA, major and regional airlines, airports, and manufacturers. Professors who are practitioners and experts in their various safety disciplines teach all of the courses. They teach not only the theory, but also the practical application of safety and incorporate "real life" experience into their presentations.

Through the Center for Aerospace Safety Education (CASE), a comprehensive short-course program is also offered in aviation safety. These are 1-2 week, 8-hour/day programs with such topics as basic and advanced accident investigation, safety program management, and human factors. These are offered three to four times per year, primarily at the resident campuses. Past students have been from airlines, manufacturers, the FAA, the NTSB, CTSB, airports, and many other aviation endeavors.

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

The Robertson Crash Laboratory, located at ERAU's Prescott Campus, offers students the opportunity to conduct hands-on field investigation of selected aircraft accident scenarios. The eight-acre facility, which is adjacent to the Safety building, includes seven fully recreated field scenario sites as well as more primitive areas in which crash simulations can be set up. Current inventory at the lab includes a variety of actual accident aircraft, such as a Cessna 401, a Piper PA-28-161, a Varga Kachina, a Snow Agplane, a Cessna 140, a Weedhopper ultralight, a Hughes 269 helicopter, a "Glasflugel" glider, the "Riddle 50" C-172 involved in a midair at Prescott, and the Scenic Airlines C208 Caravan accident from Montrose, Colo.

The Safety Information Center (SIC) within the Robertson Safety Center is a repository and technical library housing a variety of aviation safety materials. This asset allows students the opportunity to engage in academic research and study into the various safety disciplines. Current holdings include CAB/NTSB aircraft accident reports dating back to 1938; Canadian Aviation Safety Board accident reports; British AIB reports, New Zealand aircraft accident reports dating back to 1956; various safety and aviation periodicals; many research and conference proceedings reports, books, and articles; and safety statistics from several government agencies.

Further information may be obtained by contacting Professor William D. Waldock, Associate Director-CASE Prescott, Center for Aerospace Safety Education, Embry-Riddle Aeronautical University, 3200 Willow Creek Road, Prescott, AZ 86301, 928-777-6956, or by accessing the website at www.avsaf.org/case. ◆

AIR SAFETY INVESTIGATORS
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