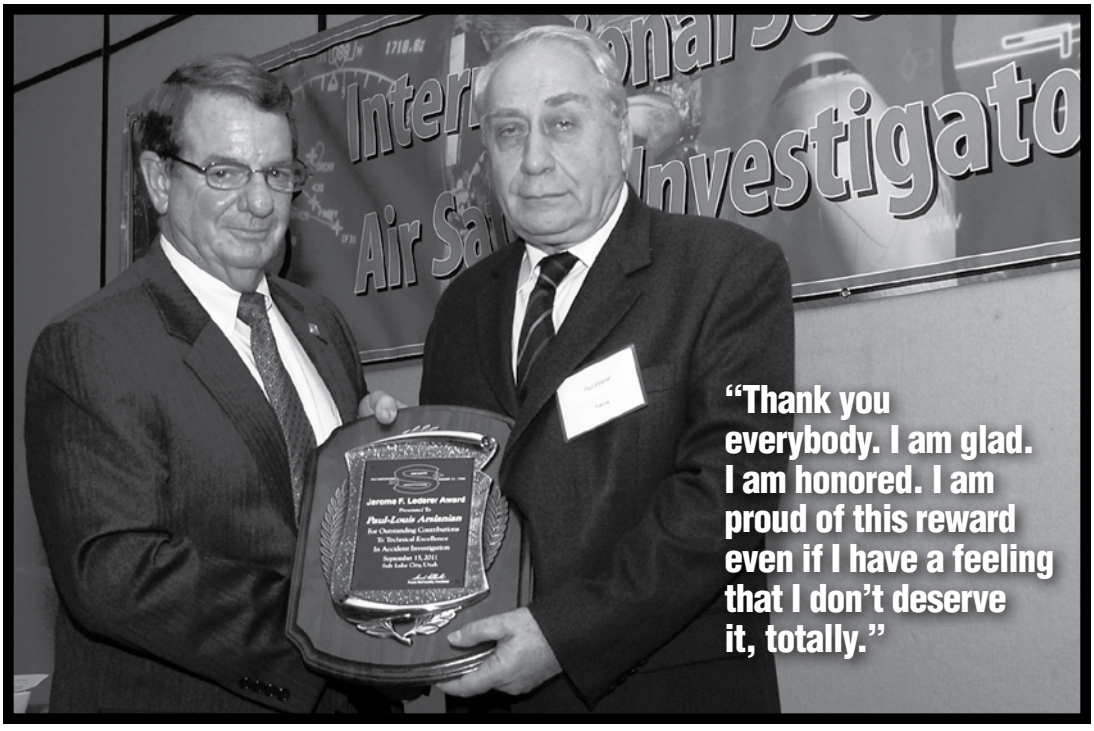
ISASI FORUM

"Air Safety Through Investigation"

OCTOBER–DECEMBER 2011



This issue is devoted to ISASI 2011 Salt Lake City

ISASI
SALT LAKE CITY
INVESTIGATION
- A SHARED PROCESS
SEPT 12 -15 2011

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Paul-Louis Arslanian (right) accepts the ISASI 2011 Jerome F. Lederer Award from ISASI President Frank Del Gandio (see page 12). Photo: Esperison Martinez, Editor

ISASI Forum "Air Safety Through Investigation"

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AIR SAFETY INVESTIGATORS
INCORPORATED AUGUST 31, 1964

Sharing Knowledge Is Vital to ISASI Goals

By Frank Del Gandio, ISASI President

(President Del Gandio's opening remarks presented to the delegates of ISASI 2011 at Salt Lake City, Utah, on Sept. 13, 2011.—Editor)

Good morning, and welcome to the International Society of Air Safety Investigators 42nd annual international seminar on air accident investigation. This is our second consecutive seminar in an Olympic city. If you looked out the window of your aircraft when you arrived here, you have some sense of the beauty of this region. The mountains that hosted the 2002 Winter Olympics are just 25 minutes from the hotel, while the Great Salt Lake is even closer. The city is the core of a growing and sophisticated urban area whose restaurants, cultural attractions, and pure vitality may surprise some visitors.

The bottom line is a vibrant city with Mother Nature just outside the door. Right now, for example, we are just about 4,200 feet above sea level, or about 1,300 meters, but we need not go far to reach 10,000 feet. The local population for a long time managed to keep all this something of a secret from the rest of us in this country, but the word is out and Salt Lake City now consistently ranks among the fastest-growing urban areas in the country.

For those who have never been here before, allow me to offer a short tutorial. First, Salt Lake City is the capital city of Utah, which was our 45th state. The state of Utah is nearly the size of the UK, though it has a smaller population: 2.8 million versus the UK's 62 million. Nearly 85 percent of those 2.8 million people live in the 100-mile north-south corridor known as the Wasatch Front Urban Corridor. In short, the remainder of the state has vast areas with very little population.

But those vast, unpopulated areas can be stunning. I encourage you to get out and enjoy this city and to see some of those areas. They include incredible places like Zion National Park, Monument Valley, and Bryce Canyon National Park. If you have never before seen some of the canyons and national parks in this part of the United States, take advantage of this opportunity. All the places I mentioned are about 300 miles southwest or southeast of here, and road connections are good. Trust me—you will thank me for this suggestion.

Finally, Salt Lake City is home to a major religion: the Church of Jesus Christ of Latter-day Saints, commonly called the Mormon Church. The forebears of today's Mormons settled this region in 1847. Temple Square, the religion's headquarters, is just a 10-minute walk from here.

We are here for the ISASI seminar, the theme of which is "Investigation: A Shared Process." The theme is a good one because it nicely captures both the history of accident investigation and the changes that have been under way in the field for some time. It captures our history because air accident investigation has been a shared process at least since the first manufacturer and early airlines tried to improve the public image of their infant industry, or since the first international investigation and, certainly, since the creation of ICAO.


President Del Gandio opens ISASI 2011.

E. MARTINEZ

Jerry Lederer, the "Father of Aviation Safety," was probably the first person to disseminate safety information. In 1928, as an employee of Aero Insurance Underwriter, he started distributing what he called "loss prevention" information to airlines, manufacturers, flying clubs, and air shows. Following World War II, Jerry found a way to achieve his passion for sharing safety information. He established the Flight Safety Foundation to disseminate safety information across commercial and national boundaries.

The earliest sharing emphasized investigative techniques and methodologies, as well as administrative procedures for conducting a competent investigation. That continues to be a critical part of sharing in our field, as we continue to learn new techniques for investigating complex accidents, and we have several papers that address those needs.

However, our profession continues to change. It has been changed by rapid improvements in investigative tools, analytical tools, and technology. More and more of our investigative work today occurs in the laboratory. During this seminar, you will hear some presentations that discuss what we have learned in the laboratory from recent accidents, including the more historical themes of techniques and methodologies, except they will be applied to investigating from the laboratory.

PRESIDENT'S VIEW

Continued . . .

The theme of a shared process is perhaps most visible in recent years in regional efforts around the world to share lessons learned and effective interventions that can work for the various cultural and political-economic systems in which aviation operates. These regional forums are making real changes in national regulations, air carrier operations, pilot training, standard operating procedures, and more. All this sharing is fundamentally based on what we learn from investigating accidents and incidents.

Yet, the most dramatic change in our profession, particularly from the public's point of view, has been our success in steadily reducing the accident rate. Due largely to our persistent success, major accidents in large portions of the world have become very rare events. In fact, accident investigators in parts of the world might become what we know in this country as the "Maytag repairman," in which the system becomes so reliable that our services are never needed.

The catch, of course, is that our services and skills continue to be needed. By my count, in 2010, we had 34 significant accidents worldwide, including 21 fatal accidents and nearly 800 fatalities.

So far in 2011, fatalities appear to be down from last year, but the frequency of significant fatal accidents is continuing. As of August 24, when I finished drafting these comments, we had already had the following major accidents:

- 77 fatalities among 105 occupants on an Iran Air B-727,
- 74 fatalities among 118 occupants on a B-727 operated by the Congo's Hewa Bora,
- 47 fatalities among 52 occupants on a Tupolev 154 operated by Russia's RusAir,
- 32 fatalities and 1 survivor when a Canadair CRJ operated by Georgian Airlines crashed in the Congo;
- 25 fatalities and no survivors on a Xian MA60 operated by Indonesia's Merpati,

(continued on page 30)

Speakers and Technical Papers Presented at ISASI 2011—Salt Lake City, Utah, U.S.A.

TUESDAY, SEPTEMBER 13

Regional Cooperation in Accident Investigations—Marcus Costa, Keynote Address, Chief, Accident Investigation Section, ICAO

Impact Modelling—Cases and Cautions—Robert Carter, UK, Principal Inspector of Air Accidents, AAIB

Flight Path Analysis—Major Adam Cybanski, Canada Directorate of Flight Safety, Canadian Forces

Using "ASTERIX" in Accident Investigation—Michiel Schuurman, the Netherlands, Senior Investigator Aviation, Dutch Safety Board, and Paul Farrell, Ireland, Inspector of Accidents, AAIU

Analysis of Fuel Tank Fire and Explosion—N. Albert Moussa, USA, BlazeTech Corp.

Preventing the Loss of Control Accident—Patrick Veillette, USA

Current State of Airline Safety Programs—Timothy J. Logan, Senior Director, Safety Rick Management Safety and Security, Southwest Airlines

WEDNESDAY, SEPTEMBER 14

Teamwork in the Cause of Aviation Safety—Sébastien David and Léopold Sartorius, France, BEA

Long Distance Investigations—Thorkell Agustsson, Iceland, Chief Inspector, AAIB

Building Partnerships in Unmanned Aviation Systems—Tom Farrier, USA, Chair, ISASI UAS WG

Timeliness, An Investigator's Challenge—John Stoop, the Netherlands, Lund University, Sweden, and Delft University of Technology, the Netherlands

Major Investigations, New Thinking Ahead—Bob MacIntosh, USA, Chief Advisor, International Safety Affairs, NTSB

Post-Turbulence Structural Integrity Evaluation—Ray Chang, C. Edward Lan, and Wen-Lin Guan, Republic of China

Who Is Onboard in GA and Air Taxi Accidents?—Bob Matthews, USA, Office of Accident Investigation, FAA

Regulatory Runway Incursion Awareness Systems—Robert Joslin, USA, Chief Scientific and Technical Advisor, Flight Deck Technology Integration, FAA

Fuel Contamination and Loss of Thrust—Marc St. Laurent, Cathay Pacific Airways; Christopher McGregor, Airbus; and Andy Cox, Rolls-Royce

THURSDAY, SEPTEMBER 15

"Back to Basics" Still Work?—Mont Smith, USA, Director Safety, ATA

Are Human Errors Considered the Same Level as Criminal Guilty?—Yukiko Kakimoto, Japan Institute of Human Factors

Pilots' Cognitive Processes for Making Inflight Decisions Under Stress—Wen-Chin Li, Ph.D., Republic of China National Defence University

Human Factors Standardized Procedures—Helena Reidemar, USA; Delta Air Lines

B-787 Safety Presentation—Thomas Dodt, USA, Chief Engineer, Air Safety Investigation, Boeing Commercial Airplanes

Air France 477 Underwater Search and Recovery Operations—A Shared Government-Industry Process—Olivier Ferrante, BEA; Michael Kutzleb, Phoenix International; and Michael Purcell, WHO

An Investigation Media/Communications Strategy—Ian Sangston, Australia, General Manager AS, ATSB

Media in a High-Profile Accident—Thierry Thoreau, France, Director, Flight Safety, Airbus SAS ◆

Regional Cooperation in Accident Investigations

By Marcus Costa, Chief, Accident Investigation and Prevention Section, ICAO

(Remarks presented by Marcus Costa in his keynote opening address to the ISASI 2011 air accident investigation seminar delegates on Sept. 13, 2011, in Salt Lake City, Utah.—Editor)

KEYNOTE SPEAKER

"Hopefully investigators will recognize the wake-up call for greater cooperation necessary to work toward identifying and reducing risk in a timely and efficient manner. This is the 'NextGen challenge' for the air safety investigators!" I read this thought-provoking message a couple of months ago in a paper that will be presented soon in this seminar. And I want to thank its author, Bob McIntosh, an old friend of ours, for allowing me to borrow his thoughts for a moment. Bob was referring to recent major investigations that demanded the pool of resources from different states in order to have the investigation properly carried out and to reach meaningful and trusted conclusions.

But I am not here to preempt Bob's presentation. I just thought his appeal for "greater cooperation," in light of recent investigations, would meet this seminar's theme fully and would be a perfect introduction to ask you the following:

Does your state have the experience and resources required to investigate a major and complex accident?

The ICAO Universal Safety Oversight Audit Program (USOAP) has answered this question to a certain extent. Audit findings indicate that a number of states have not been able to implement an effective accident and incident investigation system. The findings have been associated, in general, with a lack of resources, both human and financial. Other deficiencies are related to a lack of appropriate legislation and regulations, a lack of a training system for investigators, and a lack of equipment to conduct investigations.

You will recall that Article 26 of the Chicago Convention specifies that it is incumbent upon a state in which an aircraft accident occurs to institute an investigation into the circumstances of the accident. This obligation can only be met when an appropriate organization is in place for the investigation.

A regional investigation system can provide economies of scale by allowing for the sharing of resources, and by being a means for states lacking the required resources to undertake effective accident investigations, thus fulfilling their obligations to the Chicago Convention. Today I will focus on the first ICAO guidance on the establishment and management of a Regional Accident and Incident Investigation Organization (RAIO).

E. MARTINEZ

The manual on a Regional Accident and Incident Investigation Organization (RAIO) (Doc. 9946) was published in March this year [2011] in response to a recommendation from the last AIG Divisional Meeting. It provides guidance on the establishment and management of a RAIO and outlines the relevant duties and responsibilities of ICAO contracting states, individually and/or collectively. In so doing, Doc. 9946 assists states in fulfilling their obligations pertaining to accident and incident investigation. It is addressed to high-level government decision-makers, as it highlights states' obligations as signatories to the Chicago Convention.

From the onset, it should be noted that a regional investigation system must be "independent" and be perceived to be so. It is necessary to ensure that a clear separation exists between the organization responsible for investigations and the civil aviation authorities responsible for regulation and safety oversight. "Independence" in this regard means that the investigation organization must be functionally independent from other organizations, particularly the civil aviation authority, whose interests could conflict with the tasks entrusted to the investigation authority. Such "independence" enhances the credibility of investigations and avoids real or perceived conflicts of interest.

Some of the reasons supporting the need to establish a RAIO would be

- to eliminate duplication of efforts, pooling human, technical, and financial resources;
- to achieve economies of scale leading to improved effectiveness and efficiency;
- to enable investigators in the region to gain experience more quickly; and
- to help achieve the independence of investigations.

Some groups of states have already established a RAIO, such as the Interstate Aviation Committee representing

12 states: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, the Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. In Africa, there is the Banjul Accord Group Accident Investigation Agency (BAGAIA) consisting of Cape Verde, Gambia, Ghana, Guinea, Liberia, Nigeria, and Sierra Leone.

Funding a RAIO

Implementing a RAIO will require, among others, "commitment" on the part of member states; this is the key word to get a RAIO fully deployed.

It is important for states wishing to establish a RAIO to have a well-defined strategy. To this end, the guidance provides a model agreement that states may consider using.

Prior to the establishment of a regional investigation system, it must be ensured that member states are committed to fully support the RAIO in all aspects, including adequate funding for investigations.

Entering into an agreement to establish a RAIO requires the preparation of an estimate of the level of funding that will be required to maintain and sustain the organization in terms of organizational structure, administrative and investigation equipment, personnel training, etc.

It is advisable that states identify the resources required to establish and manage the new organization over the long term.

Given that the RAIO must be functionally independent from other organizations, including those that could be investigated (e.g., the regulatory and safety oversight authorities, airlines, manufacturers, etc.), due care regarding the sources of funding must be taken to avoid a potential conflict of interest.

Once again, the success of the regional organization will depend greatly on the commitment of its member states to fulfilling their obligations toward the RAIO, without which the RAIO will certainly fail to function effectively. The budget should specifically indicate the annual contribution required from each state and the other sources of funding that the RAIO may eventually obtain.

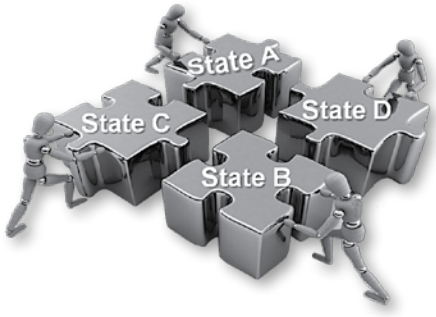
A minimum number of states is required to ensure that the establishment of a RAIO is successful. One of the avenues available for establishing such an organization is to enter into a regional agreement by signing a memorandum of understanding (MOU) or a memorandum of cooperation (MOC).

Establishing a RAIO

A minimum number of states is required to ensure that the establishment of a RAIO is successful. One of the avenues available for establishing such an organization is to enter into a regional agreement by signing a memorandum of understanding (MOU) or a memorandum of cooperation (MOC). The agreement document should emphasize the need to coordinate and harmonize the principles, rules, and procedures for conducting effective investigations in each of the member states. Once more, I note that Doc. 9946 provides a model agreement that can be used by states.

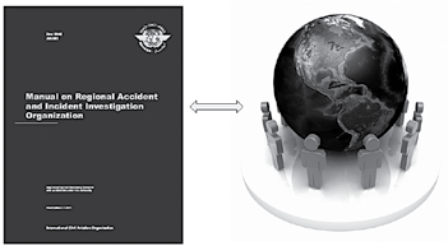
In addition to defining the legal status of the RAIO, the agreement document should also emphasize aspects and objectives so as to ensure effectiveness of the organization, such as

- The organizational and operational procedures of the RAIO need to be defined and presented in approved regulations and in a manual of internal technical policies and procedures to be agreed upon by member states.
- The RAIO should be capable of recommending necessary measures and providing technical assistance to enable member states to overcome the deficiencies identified by the ICAO USOAP and other similar audits.



- The RAIO should develop and adopt technical and operating regulations, in accordance with ICAO SARPs, for the uniform conduct of accident and incident investigations.
- The RAIO should establish a system for amending its operational regulations and procedures consistent with amendments introduced in ICAO Annex 13.
- The RAIO should be able to provide the required assistance to member states for accident and incident investigations.

The organizational structure of the RAIO, as well as its components and the primary functions of its officers, should be part of the agreement document. In this connection, the RAIO may be limited to an oversight role, while member states conduct the actual investigations.



Alternatively, the organization may be delegated the whole or part of investigations to be conducted on behalf of its member states.

The agreement document should also define the role and responsibility of each of the member states in relation to the RAIO. Other aspects to be clearly addressed during the initial stage of defining the legal status of the RAIO include

- the level of participation of a state's accident and incident investigation organization in the activities of the RAIO;
- whether the RAIO conducts its activities on the basis of a member state's national regulations or common regulations to be promulgated and equally implemented in all member states;
- which entity (RAIO or investigation authorities of member states) will be responsible for notification and reporting procedures associated with the accident/incident, as set out in Annex 13, including initial notification, preliminary report, ADREP report, and the final report; and
- what type of oversight will be conducted by member states of the RAIO to ensure the fulfillment of each member states' responsibility under the Convention.

It is important to note that the agree-

(continued on page 31)

Throughout the ISASI 2011 three-day technical program, speaker after speaker presented material that amply fulfilled the seminar theme…

INVESTIGATION
A SHARED PROCESS

By Esperison Martinez, Editor

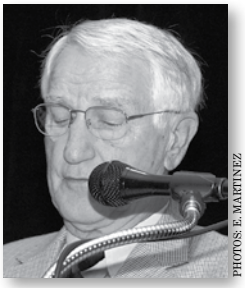
From the keynote address "Regional Cooperation in Accident Investigations" to the final delivered topic "Media in A High-Profile Accident," the 27 papers presented at ISASI's 42nd annual international air accident investigation seminar shared with the 228 delegate attendees lessons learned, experiences, and innovations in conducting investigations or developing the events discussed.

ISASI 2011 was held September 12-15 in Salt Lake City, Utah, USA. Utah, as non-local attendees may have discovered, is steeped in American Indian lore. Indeed, the name Utah is derived from the word Ute, which identifies the Indian tribe that roamed across the "land of the sun." It is aptly titled, as it was weather perfect—sunny and bright—during the conference. The venue for the four-day event was the Salt Lake City Marriot, Downtown. The hotel proved very satisfactory for all the seminar's programs. It was in the shadow of Temple Square a 35-acre complex that houses the monumental Mormon Temple and the renowned Mormon Tabernacle.

Attendee companions were the ones who truly benefited from the "land of the sun" perfect weather and bright sun and blue sky. On day one the 30 companions enjoyed a city heritage tour, visiting historical sites and seeing mountain beauty and large colorful gardens filled with flora and fauna. On day two, companions visited Provo Canyon, with its breathtaking soaring walls of stone, clay, and soil. Viewing the alpine splendor overshadowed by Mount Timpanogos was a visual "delight," as was standing at the towering start line of Olympic Park's ski jump for the 2002 Winter Olympics site. Next, Robert Redford's Sundance Resort's winding trails, gardens, and flowing streams gave respite to a weary group.

The general seminar program schedule held true to form: a tutorial workshop day and three days of technical presentations. Networking time included frequent coffee breaks, two evening social events, and an awards banquet. The usual additional-cost optional day trip to complete the week was replaced with an three-day tour visiting Yellowstone National Park, the Grand Tetons, and Jackson Hole, Wy., all open to cowboy lore and magnificent sights.

An unusually small committee of five persons orchestrated the entire event, which was under the auspice of ISASI national. Committee members included Richard Stone, Program chair and ISASI executive advisor; Barbara Dunn, Program Registration chair and National Seminar Committee chair; James Stewart, Technical Committee chair; Ron Schleede, Sponsorship chair; and Ruth Stone, Companions Program chair. Two years in planning, the event organizers crossed their fingers that the economy wouldn't deter the usual number of attendees from the seminar. And it didn't—although many registrants didn't commit until the final few weeks.



PHOTOS: E. MARTINEZ

Richard Stone

Commenting on the overall conduct of the seminar, Chairman Stone said, "Based on the many comments I heard, the seminar was a great success. We received an excellent program; generous support of the sponsors; and once again the best hotel staff, food, and accommodations in the industry by Marriott.

Tutorial workshops

Nearly 100 persons attended the two tutorials, which they believed would involve digital photography and improving aircraft integrity. To their surprise, but eventual satisfaction, they learned how the original instructors, struck by emergencies, cancelled just several days before the event. Committee resourcefulness and the spirit of "sharing" resulted in ISASI members Don Knutson and Troy Jackson unhesitatingly agreeing to substitute, no small offering on such short notice.

Don, principal of Knutson Aviation Services, presented the morning session, and Troy, with the U.S. Department of Transportation Safety Institute, led the afternoon session. Both abandoned the teaching lectern in favor of moving about the audience. Their extensive instructor background was evident. They skillfully engaged the audience and elicited very active participation. Attendees greatly appreciated the interactive atmosphere the instructors created. The audience was almost equally divided between commercial and general aviation investigators.

The morning tutorial addressed "Evaluating the Effectiveness of Our Investigation Process." About his presentation, Don said, "It's not academic, not theoretical. What I am presenting is real world. I've done or observed all that I am presenting. I've learned over the years that there is a lot of misinformation out there."

Paul-Louis displays his Jerome F. Lederer Award plaque.

The panels clockwise from above: Panel 1, Adam Cybanski, left, and Robert Carter; Panel 2, from left, Paul Farrell, Michiel Shuurman, N. Albert Moussa, Timothy Logan, and Patrick Veillette; Panel 3, from left, Tom Farrier, Léopold Sartorius, Sébastien David, John Stoop, Thorkell Agustsson, and Bob MacIntosh; Panel 4, from left, Bob Matthews, Ray Chang, Marc St. Laurent, Christopher McGregor, and Andy Cox; Panel 5, from left, Cmd. Mitchell Morrison, Helena Reidemar, Yukiko Kakimoto, Wen Chin Li, and Thomas Dodt; Panel 6, from left, Michael Purcell, Olivier Ferrante, Michael Kutzleb, Ian Sangton, and Thierry Thoreau.

He recounted how investigators may go to many different country databases seeking information, only to encounter differing findings for similar occurrences. He would pose a question of a European situation, and an audience member from the UK would readily offer insight. He then would pose the same question regarding other parts of the world, and a similar response would occur. This manner of sharing experiences continued throughout the entire tutorial.

Troy achieved "sharing" by having each person complete a worksheet before the start of his tutorial entitled "Dominoes, Cheese, and Trees: A Reflection on Accident Investigation Techniques." The worksheet's four questions related to the last accident the individual worked on. It asked, What was it? Why? How did it happen? What investigation technique was used?

Then, working through the tutorial, he invited audience responses to the subject matter. For instance, he noted that responses he got to the Why and How questions are typically human error, mechanical failure, or environmental influence, focusing on the man, machine, and environment during our investigations. He commented, "Our answer to 'How Accidents Happen?' is usually described by falling dominoes, chains of events, or holes in the cheese. Therefore, our investigation methods utilize linear cause-effect relationships. But most accidents, even general aviation accidents, are more complex and interdependent on other variables. Therefore, our perception of accidents should also include a systems perspective that includes economic, social, and regulator influences. Several systemic investigation methods that are available are accimaps, systems theoretic accident method and processes, and functional resonance analysis. Our investigator toolbox should include multiple methods to look at accidents from different perspectives."

Each tutorial session closed with a heavy number of questions being asked. Interestingly, the instructor answers were often amplified by someone in the audience. This attests to the collegial harmony that prevailed throughout both sessions. ISASI President Frank Del Gandio described the effect of the day's program thusly, "It did what tutorials are meant to do. It made you think a little differently."

The collegial relationship got a chance to bloom even more following the close of the tutorial day. That evening was devoted to the president's welcome reception, which is the first time all the registrants get the opportunity to mix and mingle. Registration for the seminar is a two-day process. By evening of the second day, travelers from near and far have settled into their accommoda-

ISASI Logo Defined

The ISASI 2011 logo was conceived as representing Utah (Delicate Arch, state symbol, in Arches National Park, Moab, Utah) and an aircraft (ISASI). The artwork was contributed by Michael Lemay at Bombardier.

Above, delegates register and collect seminar information. Left and below, delegates concentrate during the assembly.

Thought-provoking questions and comments fill the allotted Q&A time as delegates wait patiently for the microphone.

tions and are ready for the relaxation that comes with meeting old friends and making new ones before the start of the official program the next day.

Technical program

The three-day technical plenary sessions are listening-intense eight-hour days. One can generally judge the caliber of the technical matter being delivered by the attentiveness of the 200-plus persons sitting in hard straight-backed chairs along lines of tables spotted with nothing but water pitchers and note pads. The other major clue to the interest quotient is how full the assembly hall is on the last day of the program. In both instances, ISASI 2011 scored very high.

ISASI President Frank Del Gandio's welcoming remarks noted, "This is our second consecutive seminar in an Olympic city," the last being Sapporo, Japan. He extolled the virtues of Salt Lake City, calling it "a vibrant city with Mother Nature just outside the door," referring to the 100-mile north-south corridor known as the Wasatch Front Urban Corridor and the stunning vast, unpopulated areas adjoining it.

Addressing the occasion, he said, "We are here for the ISASI seminar, the theme of which is 'Investigation: A Shared Process.' The theme is a good one because it nicely captures both the history of accident investigation and the changes that have been under way in the field for some time. It captures our history because air accident investigation has been a shared process at least since the first manufacturer and early airlines tried to improve the public image of their infant industry or since the first international investigation and, certainly, since the creation of ICAO." (See page 3 for his full remarks.)

On the following day, Del Gandio revealed the name of and introduced to the assembly the recipient of the Jerome F. Lederer Award, Paul-Louis (Paul) Arslanian, former head of the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA). He gave only a short introduction commenting that the full presentation would take place at the awards banquet (see page 12).

Marcus Costa

Keynote speaker Marcus Costa, ICAO's Accident Investigation and Prevention Section chief, spoke about "Regional Cooperation in Accident Investigations." He prefaced his talk about cooperation between nations with this question: Does your state have the experience and resources required to investigate a major and complex accident? He related that a number of states do not, owing to sets of varying circumstances, ranging from a lack of financial resources to a lack of appropriate legislation and regulation, among other items.

He focused his talk on "the first ICAO guidance on the establishment and management of a Regional Accident and Incident Investigation Organization (RAIO)," the manual published in March of this year. He said, "It provides guidance on the establishment and management of a RAIO and outlines the relevant duties and responsibilities of ICAO contracting states, individually and/or collectively." He went on to detail the workings of the new guidance (see page 5 for his full remarks).

Opening remarks concluded, Chairman Stone initiated the start of the technical presentations. He began by introducing the recipients of the 2011 ISASI Rudolph Kapustin Memorial Scholarship. Two students were selected—Daniel Robert Scalese, 23, of the University of Southern California (USC), Los Angeles, Calif.; and Ainsley Marie Robson, 30, of Embry-Riddle Aeronautical University (ERAU), Daytona Beach, Fla.

Both recipients presented the essence of the essay papers that earned them the Kapustin Scholarship (see page 14). The lecture

Clockwise from top left: Companions on the winding trails of Robert Redford's Sundance Resort; welcome reception creates great "talk" time; during the three-day Rocky Mountain bus tour attendees and their spouses visit the Old Faithful geyser at Yellowstone National Park; guests mix at the relaxing reception at La Caille, a premier luxury restaurant nestled streamside at the mouth of Little Cottonwood Canyon that offers breathtaking views and authentic French cuisine.

demeanor of the two students was unexpected. Both expressed the premise of their papers with a confident forcefulness and clarity not generally found in students. They reflected very well on the screening process of the Scholarship Committee. Stone also commented on the value of the program to the future of ISASI and remarked that a mentoring program is being developed to encourage student membership. He also introduced the 17 college students in attendance and asked the delegates to share time with the future of ISASI.

In all, 27 papers were presented. Each day began with a continental breakfast and moved to plenary with multiple breaks for coffee networking time. An afternoon session followed lunch. After each set of morning and afternoon sessions, a speakers' panel responded to floor questions. Again, the quality of the presentations was apparent in the number of persons who engaged with the speakers during the Q&A sessions. It was obvious that notes had been taken and that good thought had gone into the questions asked and into the points addressed (see page 4 for a listing of authors and papers).

At the end of the first and second day sessions, ISASI societies and working groups conducted meetings in separate locations. All were well attended. Reports from the chairs of the groups will appear in future issues of *ISASI Forum*. ISASI's annual business meeting was held midday on Thursday. President Del Gandio reported that the Society was financially sound and that it rolls reflected 1,277 active members. He spoke briefly about the need for the ISASI scholarship program to gain contributions to continue maintaining its successes. A bequest of $2,000 by Jerry Lederer will be given to the Scholarship Fund, he said. He also announced that the Executive Council had authorized the formation of an ISASI student-mentoring program. He expects details to be made available in an upcoming issue of the *ISASI Forum* and asked members to share their experiences and knowledge with the future leaders of the Society.

Social events

ISASI 2011 is the 42nd such seminar. Over the more recent years, planners have come to more acutely appreciate the need for attendees to relax their minds, their attention spans, and their derriere fatigue. Built into every seminar are after-workday times that do just that. Committee planners determined that rapt attention deserves payback. This year they selected La Caille, a premier luxury restaurant nestled streamside in the mouth of Little Cottonwood Canyon. It offered breathtaking canyon views to unclutter the mind, vivid gardens with winding brick walks of a French chateau 'to ease the senses," and authentic French cuisine to excite the palate. As Chairman Stone said, "It was a most

Coffee breaks gave time for networking.

memorable and fantastic evening. We were served wine on the patio with beautiful flowers and exotic birds and then dinner in a vine-covered greenhouse. The best of the meal was the bananas foster served individually flaming."

The extra-cost post-seminar one-day excursion is always welcomed and generally, heavily attended. This year, a three-day Rocky Mountain bus tour through Yellowstone National Park, the Grand Tetons, and Jackson Hole, Wy., was offered. The 24 persons who signed up were treated to unforgettable sights of Yellowstone's wonders at an altitude of 7,500 feet: Old Faithful and sister geysers, steam vents, bubbling mud holes, emerald-blue water pools, multicolored hot springs, crystal-clear white water streams, cotton-white-clouded blue skies, and wildlife from bison to heron. After a full day of trekking in the park, and thinking the eyes could see no greater sights, the bus trip to Jackson Hole along Route 89 proved otherwise.

No one enjoys long bus trips. But one that presents vistas of grandeur mile after mile made for great enjoyment. First came the splendor of the Grand Tetons with their soaring peaks some call "tiger teeth" because of their sharp jaggedness. When passing through canyons, the cliff-like mountainsides enveloped the vehicle and seemed just an arm's length away. The mountain peaks spiraled toward the sky. Through the bus window, mountainsides became folds of hills in wave after wave of earth and rock held in place by stands of towering pine trees, many of which grew on seemingly bare rock. The entire trip, including the overnight experience in Jackson Hole, was a delight. "Very favorably impressed," is how Norway's Jon Sneltvedt, who has traveled much of the U.S., summed up his trip.

Photos of ISASI 2011 seminar activities are available for viewing online at www.isasi.org.

Awards banquet

The awards banquet is the "royal" social event that closes the three plenary days of technical talk. This formal dress occasion of the seminar sees the women in evening dress finery and men in tie and jacket, at least at evening's start.

After dinner, President Del Gandio took the stage, welcomed everyone to the peer recognition night, and highlighted by the presentation of the Jerry Lederer Award. He delivered everyone's appreciation for the seminar's outcome by introducing the many who were responsible: organizers, event planners, fundraisers, transportation providers, behind-the scene workers, hotel management, and the 18 co-host sponsors and 7 booth sponsors, among others.

Candy Del Gandio presented a special gift of a Pendleton plaid woolen throw to Ruth Stone, companions event planner, in appreciation for the hours put into developing and framing the "two great days of touring." She said, "We hope this gives you as much warmth as we received this week from you."

Next, Del Gandio recognized new corporate members who have joined during the year. The new members who received plaques were PT Merpati Nusantara Airlines, Indonesia; Flight Data Systems, Australia; and Military Accident Investigation Branch, United Kingdom. Not present was Globalaudit, S.A., Ecuador.

Ainsley Robson and Daniel Scalese, the two college students selected to receive a 2011 ISASI Rudolph Kapustin Memorial Scholarship, were then called to receive recognition of their feat (see page 14). The duo was initially introduced to the delegates during the seminar's opening sequence, but now they received the total crowd's well-deserved applause as they accepted the sym-

(continued on page 30)

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Paul-Louis Arslanian Is ISASI's 2011 Lederer Award Recipient

"Don't ever forget that investigation is an essential tool for safety and that you are very important people."—*Paul-Louis Arslanian*

By Esperison Martinez, Editor

The International Society of Air Safety Investigators crowns its annual three-day international conference on air accident investigation by presenting its highest honor, the Jerome F. Lederer Award, at the Society's award banquet. Paul-Louis (Paul) Arslanian, former head of the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) is the year 2011 recipient of the Award. ISASI, an organization dedicated to enhancing aviation safety through the continuing development and improvement of air accident investigation techniques, only considers candidates for its highest award who have careers of making outstanding lifetime contributions to technical excellence in furthering aviation accident investigation and achieving ISASI objectives.

Introducing the award winner to the banquet guests, President Frank Del Gandio said, "During his close to 30 years in aviation safety investigations, Paul has been a strong supporter of ISASI activities as BEA corporate member and as participant, speaker, and keynote speaker at many of our annual seminars, as recently as 2009 in Orlando, Fla. We are very proud to have such a worldwide-recognized safety investigation expert among our corporate membership. He is a most deserving recipient of the ISASI Jerry Lederer Award."

President Del Gandio noted that Paul, having reached the French civil service retirement age, retired in October 2009. He joined the BEA in 1986 and became head of the BEA, the official French independent organization within the Ministry of Transportation in charge of technical investigations into civil aviation accidents and incidents, in 1990. He remains with the agency in a limited capacity.

His résumé shows Paul is a graduate from the Ecole Polytechnique in Paris and the Ecole Nationale de l'Aviation Civile in Toulouse. Upon graduation, he joined the Direction Générale de l'Aviation Civile (DGAC), for which he worked for 17 years. During this period, he gained experience in aviation matters by acting as attaché to the minister of transports and by holding various positions at the departments of Air Transportation and Civil Aeronautical Programs. In the latter, as deputy director, he was instrumental in structuring in France activities in the fields of research and avionics related to civil aircraft development. In 1980, he was entrusted with environmental issues at DGAC, thus getting acquainted with international relationships and ICAO.

In speaking of Paul's safety and accident investigation experience, President Del Gandio said, "Since 1986, Paul has taken part in more than 10, 000 investigations in France, including its overseas territories, with a direct or managerial participation. Also, through France's role as state of manufacture for the Airbus, ATR, and Falcon airplanes and Eurocopter helicopters, as well as state of the operator for French airlines, he has obtained wide experience in accident investigation abroad. Through his worldwide involvement into a number of investigations of air transport disasters, he has developed a unique expertise into the management of such situations, including setting up resources, handling various types of needed communication, including drafting and issuing safety recommendations, and managing crisis situations.

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Paul-Louis Arslanian (right) accepts the ISASI 2011 Jerome F. Lederer Award from ISASI President Frank Del Gandio.

"On the international scene, from 1980 to 1990, he obtained experience and a reputation as a leading member of the European and ICAO committees on aviation noise. Since 1991, he has been the chairman of the Accident Investigation Committee (ACC) of the European Civil Aviation Conference (ECAC). In this capacity, he actively contributed to working cooperatively on safety matters within Europe and with other regions of the world. He played an important part in organizing a structured network of safety investigation authorities and into drafting, at ICAO and at the European level, regulatory texts for the effective and independent investigation of accidents and incidents.

"During all these years, he promoted systematically and with conviction international friendship and the central role of ICAO for establishing true aviation safety and organizing fair international relationships in this field. In 1992, he was elected chairman of the ICAO AIG/92 Divisional meeting, during which he contributed to the international recognition of the importance of the investigation of incidents. In 2001, during ICAO's 33rd Assembly, he was elected chairman of the Technical Committee, a confirmation that his reputation goes beyond the investigation community."

Following his comments outlining Paul's professional career, President Del Gandio said: "Paul has always been a strong supporter of ISASI and has more than filled the criteria to receive the ISASI Jerome F. Lederer Award." Then, turning and

speaking directly to Paul, he said, "I have known you for a long time and these words of introduction don't really do you justice. I am very happy to present you our highest award and proud I can do it. On behalf of everyone here, I congratulate you."

After the thunderous audience applause, Arslanian put the crowd at ease with a little humor. He then turned serious and said, "Thank you very much. Thank you everybody. Indeed, I am glad; I am honored; I am proud. I am proud of this reward even if I have a feeling that I don't deserve it, totally. What did I do? Not much, if to do something means that you do it alone. Thinking back and reviewing my period in aviation, I realize that I, in fact, always worked within a team; always worked in close cooperation with other people. I have a real feeling that all those people I worked with deserve this reward as much as I do."

He referred to what he calls his aviation families. "Accordingly, I wish to share this award with the three families I found in aviation. The first, of course, is the BEA, my dear, my beloved BEA with which I still feel a very close relationship. It is filled with so many great people; along the years, I had the privilege to work with so many bright young people who joined us and did a great job, showing a total dedication to aviation safety. And let me express a special thank you to my successor who did me the favor to be here tonight with me; he is now in charge, and I wish him all the best.

"My second family is the ECAC/ACC group. In Europe, together, we achieved something extraordinary. In 1991, when it all begun, we were only investigators, from separate countries. When we met, it was usually here in the U.S. because you already had an established tradition of international gatherings. But now, we are more than colleagues; we are close friends, trusting and helping each other as brothers do. And those who join us now discover a kind of relationship that is really special, regardless of the various languages or backgrounds, regardless of possible national interests and regardless of history.

"Finally, my third family is ICAO, which is a great, really great, organization and a very large one as well. It is filled with people from all countries who are seriously devoted to their jobs of serving the international aviation community, and through this, of serving peace and prosperity for the peoples of the world"

Next, he shared some of his insight, rhetorically asking, "What are my ideas? What can I add to what was excellently said during this seminar?" In response he said, "Firstly, I wish to stress that safety investigation is absolutely not obsolete. These days, some people are expressing the view that investigation belongs to the past, that now is the time for a different approach that alone will guarantee aviation safety. I say a loud NO! Safety investigation is not only an unavoidable part of the transport activity and you can't get away from it, but also, above all, when conducted according to the spirit of Annex 13, it is a modern and highly effective tool for the enhancement of safety. And to fulfill the task, we need qualified and motivated investigators. Don't ever forget that you are in charge of an essential tool and that you are very important people."

Commenting that air safety investigators should not consider themselves as dinosaurs, he continued saying, "Aviation is a complex system. Aviation is changing every day. Aviation is filled with new challenges. This is why, in order to guarantee its safety, it doesn't look possible to rely only on a predictive approach. It is necessary also to make capital out of experience, to build on what we learn from the field. Prediction is not a replacement for correction. Prediction and correction are in fact two faces of the same coin. A high level of safety implies the permanent screening of available data to identify unforeseen hazards or to better assess risks. Even when it is called proaction, this is indeed a reactive process: it needs feedback data, sometimes from the unpredictable. That is why you will not be replaced. Who better than a professional investigator is able to provide validated and documented data?

"Now, as a bonus, let me add something that I learned over time: for complex systems, progress does not, and cannot, proceed only from a mere analysis of facts; serendipity, finding something by accident, plays a great role, providing you are able to understand its importance. Our investigations are an attempt to structure serendipity, through an open-minded, systematic and in-depth examination of unpredicted events."

In concluding, he spoke of the investigator's social role: "Investigations are also, of course, a unique incentive for safety changes, through the release of reports and of recommendations, especially those dealing with systemic shortcomings. But remember that you are faced with two highly contrasting environments, according to the event: on the one hand incidents or minor accidents, and on the other, disasters. In the former, you mostly work with other safety professionals and you focus on safety matters only. In the latter, you have to address other tasks also, like the protection of evidence or the timely release of information, moreover, other people step in, news media, political, law enforcement, upper management, etc. These additional and unprepared people generally create problems to the investigation—they generate confusion, controversy peeps around, and even a crisis may arise. It's part of the job to handle such difficult situations and keep the confidence of all safety stakeholders. Indeed, thorough training and preparation can help, but be aware that you will never be truly ready, never be really prepared, because every time it is a new situation. Be confident; however, the quality of your work and your professional behavior are your best assets. Do you best, and good luck!" ◆

Past Lederer Award winners

1977—Samuel M. Phillips
1978—Allen R. McMahan
1979—Gerard M. Bruggink
1980—John Gilbert Boulding
1981—Dr. S. Harry Robertson
1982—C.H. Prater Houge
1983—C.O. Miller
1984—George B. Parker
1985—Dr. John Kenyon Mason
1986—Geoffrey C. Wilkinson
1987—Dr. Carol A. Roberts
1988—H. Vincent LaChapelle
1989—Aage A. Roed
1990—Olof Fritsch
1991—Eddie J. Trimble
1992—Paul R. Powers
1993—Capt. Victor Hewes
1994—UK Aircraft Accidents Investigation Branch
1995—Dr. John K. Lauber
1996—Burt Chesterfield
1997—Gus Economy
1998—A. Frank Taylor
1999—Capt. James A. McIntyre
2000—Nora C. Marshal
2001—John W. Purvis and the Transportation Safety Board of Canada
2002—Ronald L. Schleede
2003—Caj Frostell
2004—Ron Chippindale
2005—John D. Rawson
2006—Richard H. Wood
2007—Thomas McCarthy
2008—C. Donald Bateman
2009—Capt. Richard B. Stone and the Australian Transport Safety Bureau
2010—Michael Poole

ISASI 2011 Lauds 'Kapustin' Scholars

Recipients of the 2011 ISASI Rudolph Kapustin Memorial Scholarship received well-deserved recognition from ISASI's annual air accident investigators conference attendees.

By Esperison Martinez, Editor

Daniel Robert Scalese, 23, University of Southern California (USC), Los Angeles, Calif., and Ainsley Marie Robson, 30, Embry-Riddle Aeronautical University (ERAU), Daytona Beach, Fla., year 2011 recipients of the ISASI Rudy Kapustin Memorial Scholarship, beamed with cheer at the applause they received from the 228 delegate attendees at ISASI 2011.

The Scholarship, established in memory of all ISASI members who have died, was named in honor of the former ISASI Mid-Atlantic Regional Chapter president, a staunch advocate of the Society.

ISASI Executive Advisor Richard Stone and former ISASI Vice President Ron Schleede administer the fund. It is intended to encourage and assist college-level students interested in the field of aviation safety and aircraft occurrence investigation. A major application requirement is the completion of 1,000 (+/- 10%) word essay in English addressing the challenges for air safety investigators.

The Scholarship awards US$2,000, a one-year ISASI membership, and a fee-free attendance at an accident investigation course at the FAA's Transportation Safety Institute, the Southern California Safety Institute, or the Cranfield University Safety and Accident Investigation Centre. No dues funds are used to support this program. It is totally dependent upon voluntarily (tax free in the U.S.) contributions.

E. MARTINEZ

From left are ISASI President Del Gandio, scholarship receipient Daniel Scalese, ISASI Executive Advisor Richard Stone, and scholarship receipient Ainsley Robson.

Daniel Scalese is completing his undergraduate work in aerospace engineering and mathematics at USC. Born in Dillon, Mont., USA, he calls Big Sandy, Mont., his hometown. His interests are varied: flying, rowing, aircraft design, and automobiles. Daniel plans to "do graduate study at the University of Southern California, either full time or part time while working in the aviation industry toward a career in aircraft design, aerodynamics, or air accident investigation."

Ainsley Marie Robson is pursuing twin master's degrees: science in aeronautics (specialization in aviation/aerospace safety systems) and business administration (specialization in airport administration) at ERAU, Daytona Beach, Fla. She expects to complete her studies in 2012. Her permanent home is in Levittown, Pa., USA, but she was born in Trenton, N.J.

Ainsley's interests include boating, horseback riding, skiing, reading, shopping, photography, and traveling. Her professional leanings are toward safety, marketing, public relations, operations, and international affairs. Asked if she holds a pilot's license, she responded, "Nope, but it's on the bucket list of things to do." As for her future she says, "Like any student, my future plans included working toward graduation and finding that ever-elusive job in the aviation industry."

Her professional aspirations? "One day I would like to work in a position where many of my different interests and skills can be combined into one job."

The Scholarship essays of the awardees as judged by Richard Stone and Ron Schleede follow. ◆

Safety Factors Unique to Remotely Piloted Vehicles: The New Challenges for Air Safety Investigators

By Daniel Scalese

Factors causing aircraft accidents often repeat themselves. For more than a century, investigators have developed proven methods to determine the causation of manned aircraft accidents. Yet investigations of accidents involving remotely piloted vehicles, or RPVs, are relatively new, and

few investigators have encountered this challenge. This paper seeks to identify the unique factors that contribute to RPV accidents.

After investigating NASA's Aviation Safety Reporting System (ASRS) database, the records of the U.S. Air Force (USAF) Accident Investigation Board, the National Transportation Safety Board, the U.S. Department of Transportation, and research conducted by NASA's Dryden Flight Research Center, several factors were found to be uniquely prevalent in RPV incidents. These include elevated complacency, not understanding basic differences between manned aircraft and RPVs, limited pilot situational awareness, poor control interface design, and basic computer failures. The following will present specific, documented incidents caused by these factors.

Records suggest a higher level of complacency in RPV operations than manned operations. As RPV operations risk no lives, crews cut corners in ways not commonly encountered by investigators. In 2004 the USAF lost a Predator A to fire when a mechanic wrapped an oil line around a cylinder head, suggesting maintenance complacency. In 2009 another USAF Predator A crashed when a single computer chip, intentionally glued instead of soldered onto the motherboard as recommended, jarred loose during normal flight. Members of a manned operation would likely heed such recommendations. Investigators should not assume operators will know better than to make such seemingly elementary mistakes. Without lives at risk, these mistakes appear much less serious to operators and complacency arises. Investigators must not overlook this complacency.

Crewmembers do not survive the worst aircraft accidents, yet always survive accidents involving RPVs. This, however, will not simplify investigations, as operators may not realize differences between RPVs and manned aircraft. For example, the Predator A's autopilot uses altitude to control airspeed, where manned USAF aircraft use power. An uninformed veteran pilot may not realize this during or after an incident. Such an incident may have occurred in June 2010, when a suspected but undiagnosed RPV autopilot malfunction caused an altitude deviation. Veteran accident investigators must consider these differences between manned aircraft and RPVs in their investigations.

RPV operators experience a lack of situational awareness without precedent in aviation. They rely only on instrumentation and cameras with limited fields of view. One report offered by NASA summarizes the condition as such: "You can't hear the engine RPM fluctuating; you can't feel vibrations, acceleration, or motion; you can't smell the fuel leak; you can't taste the electrical fire; and you lose vision in one eye." The results show in accident investigation reports. In 2001, the pilot of a USAF QF-4E Phantom target drone did not recognize an attitude instrumentation error on takeoff until moving down the runway at more than 250 knots; he then overcorrected and crashed. The report cites a lack of "seat of the pants feedback."

RPV operators experience a lack of situational awareness without precedent in aviation. They rely only on instrumentation and cameras with limited fields of view.

A related incident occurred in 2008, when a MQ-1B Predator pilot attempted a 45-degree aileron-only turn after overshooting the runway, resulting in a catastrophic loss of control. Investigators have encountered accidents caused by a lack of situational control before, perhaps the most notable example being the 1979 crash of American Airlines Flight 191 in Chicago, when the stall stickshaker lost power. The NTSB report states that with a working stall warning system, the pilots could have recognized the situation sooner and saved the flight. The report lists this lack of situational awareness as a probable cause in one of the worst disasters in aviation history. Yet, such a lack of situational awareness is standard operating procedure for RPVs. Investigators should consider the inherent lack of situational awareness in RPVs, not just how they were not accounted for.

Poor interface design has also caused RPV accidents and incidents despite the best efforts of pilots flying with limited situational awareness. No regulations exist for RPV control stations, and many are simply desks with a joystick, rudder pedals, keyboard, trackball mouse, some switches, and monitors. Investigators found one fatal design flaw after a 2006 USAF MQ-1B Predator A crash. The pilot intended to press the landing gear switch, but instead pressed the neighboring engine kill switch. With such a design, a finger inching away from its intended target would cause disaster on takeoff and landing.

The Department of Transportation found a slew of further design problems. Predator A pilots needed seven seconds to deactivate the autopilot, navigating through four menus with the keyboard and mouse, where manned aircraft pilots have a single switch. Furthermore, U.S. Army RQ-7 Shadow and USAF RQ-4 Global Hawk pilots don't even have flight controls and must input altitude, airspeed, and heading into a computer. These pilots cannot deactivate the autopilot, greatly increasing reaction times. With such control interfaces, it's a miracle that pilots can properly react to anything. When RPVs have such poorly designed control systems, investigators should attribute accidents to design and not a perceived lack of training.

Yet, after overcoming complacency, aircraft not conforming to established standards, a lack of situational awareness, and poorly designed control interfaces, RPV operators must still contend with computer failures. Without a pilot on board, RPV operators must place complete trust in computers. Comput-

The ISASI Rudy Kapustin Memorial Scholarship, established in memory of in honor of the former ISASI Mid-Atlantic Regional Chapter president, a

ers violated this trust in 2000, when a USAF Predator A pilot chose the wrong menu option, causing the RPV's primary computer to erase its memory and ignore control inputs. Investigators should attribute such incidents not to poor interface design but to the fundamental structure of the hardware and software that makes the RPV fly.

Few investigators have investigated an incident involving remotely piloted vehicles. Yet, in 2010 the USAF bought more RPVs than manned aircraft, and untold numbers of civilian RPVs will enter airspaces following government approval. Past incidents show that certain factors particularly contribute to RPV accidents. These include complacency, unfamiliarity with non-standard aircraft, lack of situational awareness, poor interface design, and computer failures.

To help investigators, this paper makes the following recommendations. Investigators must look beyond any errors to the operator's culture; it will almost certainly differ from that of a manned operation. They must not rely on previous standards and procedures for manned aircraft, no matter how well established. They must understand that RPV operators always lack situational awareness and not consider that an accident's root cause. They must give greater attention to the control interface design, and they must find the root cause of any computer failure, as RPVs have no human backup. ISASI should take the lead in bringing these recommendations to the attention of investigators, as RPV accidents will undoubtedly continue. ◆

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A Rising Challenge for Air Safety Investigators: The Concept of Criminalization With Air Safety Investigations

By Ainsley Robson

When you receive the phone call that you have been selected as an investigator in response to a recent airline accident, you must be ready to grab your "go" bag and head out. On the way, you make a mental checklist of the things that will need to be done in accordance with individual country regulations. You think about the objective of the investigation, in accordance with Annex 13, Aircraft Accident and Incident Investigation, of the International Civil Aviation Organization (ICAO). The last thing on your mind is the possibility of information being withheld due to the fear of criminal charges. One of the challenges that investigators face today is that criminal charges can be brought forth as a result of an accident investigation, which is in conflict with the intended purpose of the investigation.

The concept of being charged criminally during an airline investigation varies from country to country, but there are common elements held within these criminal charges (Darby, 2011). Rick Darby also indicates that the number of aviation cases criminal charges has risen from 27 (from 1956–1999) to 28 cases (from 2000–2009). This rise in number of aviation-related criminal charges has caused concerns throughout the air safety industry and with investigators.

As concerns grow, questions arise. One such question at the top of everyone's list is what should be done about the use of aviation investigations being used for purposes other than their intended purpose? The slightest threat of criminal charges could hinder the investigator's ability to discover the true chain of events. When exploring the cause for criminal charges, it usually comes down to common law versus civil law.

With further exploration into each of these types of laws, there are some dramatic differences that become evident. Common law, which is derived from the statutory and case law of England, is based on the customs that were previously established prior to written law (Guillou, 2009). This type of law is rooted in knowledge of legal precedent relevant to the facts before them (Guillou, 2009). Common law therefore requires the lawyer in a criminal case to show how new evidence has proven to be relevant in previous cases. The lawyer needs to

all ISASI members who have died, was named staunch advocate of the Society.

prove that the evidence is connected to the case. For this reason, in the United States, parallel investigation is required to be conducted by the Federal Bureau of Investigations (FBI). They are tasked with determining whether there are criminal intentions separate from the safety investigation. If it is proven fact that there are criminal intentions connected to the accident, the FBI then becomes the lead investigator (NTSB Investigative Process, 2011).

The second legal structure, which can be traced to the time of Roman law, is the civil law system. This is where the populace determined the laws of the land. The primary difference from common law is that it is a system based on legislation developed as the primary source of the laws. A judge typically oversees the proceedings (Guillou, 2009). As a norm, these legal systems do not mix. In international industries, such as aviation, there is a need to make the systems agree.

With the current trend to establish the criminal cases in both legal systems, it is only logical to note the stress placed on those who work within the aviation industry. As the number of criminal charges increases, it seems that eventually investigators will lose information gathered from interviews, unless in the presence of a lawyer. This would create increased difficulties for investigators. With increase time between the accident and the interviews, the information that is held by the interviewee begins to have gaps. It has been shown that the further back someone has to remember, the more that details of the event become vague. This raises the risk of investigators potentially missing key information to the accident. Another risk that is associated with waiting is the possibility that eyewitness statements become unobtainable.

Seeing the need for international cooperation, a Joint Resolution Regarding Criminalization of Aviation Accidents was developed and signed by the developers in 2006. Among the signatures were leaders of the Royal Aeronautical Society in London, the Académie National de l'Air et de l'Espace in Paris, the Civil Air Navigation Services Organization in Geneva, and the International Society of Air Safety Investigators, which added its signature in 2010 (Quinn, 2007 and Flight Safety Foundation, 2010). The signatures are intended to show resolve toward the overall idea that an aviation accident investigation should be to determine the probable cause of and contributing factors in the accident, and not to criminally punish those who work within aviation (Flight Safety Foundation, 2010). The resolution also calls for stricter guidelines to initiate criminal charges and asks for the safeguarding of safety investigation reports from premature disclosure in order to be used in civil or criminal cases. The resolution further urges the governing bodies around the world that deal with accident investigation to work on improving key elements in support of the resolution.

If the current criminalization trend continues, there is a higher chance of it negatively impacting more areas of the aviation industry. The best way to combat the criminalization of aviation investigation is through the continuing education of not just the safety industry, but also others who can interfere with the investigation process.

Since the original signatures on this resolution, criminal cases continue to be seen as a reaction to aircraft accidents, and new criminal investigations have been announced. In December 2010, the French magistrate announced the conviction of involuntary manslaughter against Continental Airlines and a mechanic at the airline in conjunction with their involvement in the 2000 Concorde accident of Air France Flight 4590 (Flottau, 2010). Currently, this case is undergoing the appeals process, but for those involved, the damage is done (Flottau, 2010). Another criminal case in the works involves Air France Flight 447. In March 2011, the French magistrate placed Air France and Airbus under official investigation for their involvement in the crash two years ago (Curt Lewis, 2011). Both of these individual actions from the French magistrate renewed concerns about the misuse of the investigation process.

There is a need to protect the investigation process and ensure it is used for the purpose for which it was created. Without the accident investigation process, those who provide information changes and improvements to the overall safety of the industry cannot continue. If the current criminalization trend continues, there is a higher chance of it negatively impacting more areas of the aviation industry. The best way to combat the criminalization of aviation investigation is through the continuing education of not just the safety industry, but also others who can interfere with the investigation process. ◆

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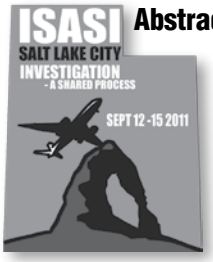
AIR FRANCE 447 UNDERWATER SEARCH AND RECOV

A Shared Government-

By Olivier Ferrante (BEA)[1], Michael Kutzleb (Phoenix International)[2], and Michael Purcell (WHOI)[3]

AWARD OF EXCELLENCE

(In publishing the winner of the Best of Seminar Award of Excellence for technical papers presented at ISASI 2011 in Salt Lake City, Utah, on Sept. 15, 2011, Forum *is departing from its usual editorial format and is publishing this paper in its technical paper format as accepted by the ISASI 2011 Seminar Technical Committee.—Editor)*



Abstract

On June 1, 2009, Air France (AF) Flight 447, an Airbus A330-203 registered F-GZCP, disappeared over the ocean while flying enroute between Rio de Janeiro (Brazil) and Paris-Charles de Gaulle (France). Twelve crewmembers (three flightcrew and nine cabin crew) and 216 passengers were aboard.

The estimated area of the accident was over the Mid-Atlantic Ridge close to the equator and more than 500 nm from the coastline. The search efforts had to proceed in an unfavorable environment due to the depth and the topography of the seabed. The bathymetry and currents of this area were little known at the time of the accident. The absence of any trace of the accident in the first days and the absence of an emergency distress message and radar data complicated the search efforts. This was the first time the aviation world and oceanographic specialists had to face such a difficult and challenging search. The wreckage was ultimately discovered at a depth of 3,900 m, 6.5 nm north-northeast of last position transmitted by the airplane, on April 3, 2011, during the fourth search campaign after considerable search efforts.

This paper summarizes the four undersea search campaigns and the recovery campaign undertaken between June 1, 2009, and June 16, 2011. They eventually enabled the recovery of both flight recorders, numerous aircraft parts, and human remains (HR). The total cost of the underwater search operations is evaluated at 34.6 million Euros.

The successful recovery of both flight recorders was a major step for the BEA safety investigation. These search efforts to find the wreckage and solve the enigma of the Rio-Paris flight required wide-ranging international government-industry cooperation in which

- the Woods Hole Oceanographic Institution played a key role in the successful location of the wreckage, and
- Phoenix International was instrumental in the search and recovery of the two flight recorders.

It is hoped that the lessons learned by teaming investigators with industry and the safety recommendations released by the BEA during that process will first prevent the recurrence of the AF Flight 447 accident, and in case of accidents at sea, prevent future similar complex and challenging sea search operations.

Introduction

On June 1, 2009, AF Flight 447, an Airbus A330-203 registered F-GZCP, disappeared over the ocean while flying en route between Rio de Janeiro (Brazil) and Paris-Charles de Gaulle (France).

Beyond radar coverage, the only available indications of the airplane's position were the reporting points transmitted automatically via satellite by the Aircraft Communications

AWARD OF EXCELLENCE

Olivier Ferrante, Michael Kutzleb, and Michael Purcell earned the ISASI Award of Excellence for their paper "Air France Underwater Search and Recovery Operations—A Shared Government-Industry Process," which was judged Best Seminar Paper of those papers presented at the ISASI 2010 seminar on aviation accident investigation held in Salt Lake City, Utah, Sept. 12-15, 2011.

The Award was established through an anonymous donation by an ISASI member who wished to acknowledge a paper at the annual seminar that made an outstanding contribution to the advancement of technical methodologies in aircraft accident investigation. The Award of Excellence carries a US$500 prize. The authors have announced that they are contributing the $500 to the ISASI Rudolph Kapustin Memorial Scholarship Fund.

E. MARTINEZ

Displaying the Award of Excellence plaque presented by ISASI President Frank Del Gandio are, left to right, Michael Purcell, Michael Kutzleb, Del Gandio, and Olivier Ferrante.

ERY OPERATIONS—
Industry Process

Addressing and Reporting System (ACARS). The last known position (LKP) was transmitted at 02 hours 10 minutes UTC. From ACARS messages, it was determined that the airplane flew for a maximum of five additional minutes, which meant that the wreckage had to be within a circle with a radius of 40 nm (75 km) centered on the LKP. This area extends over more than 17,000 km² and is situated more than 500 nm from the coastline.

Considerable international air and naval forces were mobilized to search for signs of the airplane and any possible survivors. The first floating debris was identified and recovered on June 6, 2009, within the circle, approximately 70 km to the north of the LKP. Floating debris, continuously drifting northward, was found over the next week.

Four undersea search campaigns and one recovery campaign were undertaken, which eventually enabled recovery of both flight recorders, numerous aircraft parts, and HR. The operations officially ended on June 16, 2011, when the C/V (cable vessel) *Ile de Sein* unloaded its containers in Bayonne, France. This was slightly more than two years after the accident.

This paper summarizes the methods and the means used during the five phases of the underwater operations.

I) Summary of Phases 1 through 3 and preparation of Phase 4

The acoustic searches (known as Phase 1) aimed at detecting the acoustic signals transmitted by the Underwater Locator Beacons (ULB) on the recorders. As a priority, a vast zone was swept by Towed Pinger Locator (TPL)[4] along the airplane's projected trajectory as well as the greatest possible area within the circle. On June 22 and 23, 2009, within the 30-day certified transmission period of the ULBs, the hydrophones were operating in close proximity to the debris field. However, no acoustic signal was detected. The post-recovery examination of the CVR's ULB showed that it was damaged on impact. The other ULB was separated from the FDR and never found. Extensive tests on the recovered beacon showed that it could not transmit with a new battery. There is a strong probability that both pingers were not transmitting when the hydrophones were towed near their location. However, the range and propagation conditions for the acoustic signals at the wreckage site are not known and could have been the reason that no signal was received. The BEA has been studying this issue since the accident.

At the end of the ULB transmission period, the only possible means for locating the wreckage was through the use of sonar

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Olivier Ferrante *joined the BEA in 2000 as the head of the safety analysis division. In early 2004, he was responsible for coordinating the underwater recovery operation off Sharm el-Sheikh (Egypt) after the Flash Airlines B-737 accident. He was detailed to the FAA in 2006 and 2007 to work on data sharing and risk modeling under a BEA-FAA cooperation agreement. He also worked with the Commercial Aviation Safety Team (CAST) in the JIMDAT sub team. Olivier holds a master's in aviation engineering from the French National Civil Aviation School (ENAC). He is also a pilot and a certified diver. He coordinated the Air France 447 search and recovery operations from June 1, 2009, to June 16, 2011. He is currently the secretary of the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA) for technical aspects.*

Michael K. Kutzleb *has more than 30 years' experience in the location and recovery of objects lost in the ocean. Following graduation from college, Mike went to work full time with Seaward, Inc., which then held the U.S. Navy's search and recovery contract. He has participated in more than 120 search and recovery projects in all water depths. Nearly 100 of these search and recovery tasks involved searching for lost aircraft in order to assist air safety investigators in determining the cause of the crash. He has hands-on operational experience with all types of search systems as well as remotely operated vehicle (ROV) systems for recovery operations ranging from small, shallow water inspection ROVs to large work class ROVs capable of operating in water depths to 6,000 m (20,000 ft). In 1997, Mike started a new marine services company, Phoenix International, Inc., and now serves as its president. Phoenix worked for the BEA in the first three phases of the mission to locate the wreckage from Air France Flight 447 lost off Brazil in 2009, and was hired to recover the flight data and cockpit data recorders, human remains, and other pieces of the aircraft as requested by the onsite investigation team.*

Michael Purcell *is a senior research engineer in the Oceanographic Systems Lab at the Woods Hole Oceanographic Institution. He has a B.S. from Florida Atlantic University and an M.S. from Massachusetts Institute of Technology, both in ocean engineering. Research interests include design, development, and testing of underwater vehicles, instruments, systems; ROV handling systems and AUV launch and recovery systems; and material applications in underwater systems. Design accomplishments include the first underwater docking system for REMUS 100, vertical profilers for the LEO-15 underwater observatory, the Martha's Vineyard Coastal Observatory underwater node, the REMUS 6000 AUV and many components of other REMUS AUVs, multiple AUV launch and recovery systems, and multiple ROVs. Currently, he also manages the REMUS AUV operations group and led the recent successful search for AF Flight 447 wreckage in the equatorial Atlantic.*

detection. A first attempt was made from July 27 to Aug. 17, 2009, (Phase 2) with the IFREMER deep-towed side-scan sonar called SAR (operating on 180 kHz). Although this search turned out to be unsuccessful, this phase enabled the BEA to carry out a complete bathymetric survey of the circle (see Figure 1) thanks to the multi-beam echo sounder mounted on the hull of the research vessel (R/V) *Pourquoi Pas?*. This hull-mounted sonar also acquired 12 kHz and 24 kHz acoustic images. The IFREMER team aboard the R/V *Pourquoi Pas?* developed a methodology based on the analysis of the various acoustic images, which was subsequently used during the next search phase.

After Phase 2, it was estimated that covering all of the remaining 17,000 km² circle would take at least six months. In order to reduce this time, a smaller search zone was defined by evaluating the drift of the debris between the time of impact and the time the floating debris was recovered. To do this, the BEA called upon a group of experts from international oceanographic institutes. The proximity to the equator affects the modeling of the currents in the estimated accident zone. The lack of available in-situ data and the complex oceanic dynamics (notably due to the seasonal start of the north-equatorial counter-current during the month of June) also made it difficult to model the marine currents. These factors contributed to making the reverse-drift computations complex. However, the group was able to define a reduced area of 2,000 km², located to the northwest of the LKP, which had a high degree of probability of including the site of the impact.

Phase 3 consisted of two search periods on site from April 2-25, 2010, and from May 3-24, 2010. The ORION deep-towed sonar and the three REMUS[5] 6000 autonomous underwater vehicles (AUV) operated by the American Woods Hole Oceanographic Institution (WHOI) explored an area of nearly 6,300 km². This search turned out to be unsuccessful as well.

The lack of success during the first three search phases led the BEA to undertake a complete review of both the means used and the zones explored. In particular, to check the predictive ability of the reverse-drift computations, the BEA asked the French Navy to drop nine drift buoys in the area the accident site at the beginning of June 2010. These SLDMB[6] buoys were tracked by satellite to follow the evolutions of surface currents. Their trajectories demonstrated the turbulent nature of the currents in this region and thus the difficulty of predictions.

The BEA also contracted Metron to review the results from the previous searches and to produce a probability map for the location of the underwater wreckage. To accomplish this Metron used SAROPS[7] and a prior distribution based on studies by the BEA and the Russian Interstate Aviation Group (MAK) dealing with nine previous accidents that had occurred while the airplanes were in cruise.

Metron analyzed the effectiveness of Phase 3 side-looking sonar searches and computed an updated probability distribution for the location of the wreckage using the new prior distribution and incorporating the unsuccessful Phase 1 and 2 searches, as well as the photos and ROV searches. The unsuccessful aerial and ship searches performed June 1-6, 2009, were also taken into account.

Analysis of all the results from the previous searches indicated that the zones that had previously been searched using sonar did not need to be explored again. This was why Phase 4 was based on the strategy of a systematic search of all of the zones not explored up to then during Phase 2 by the IFREMER deep-tow sonar and during Phase 3 by the REMUS and ORION sonars.

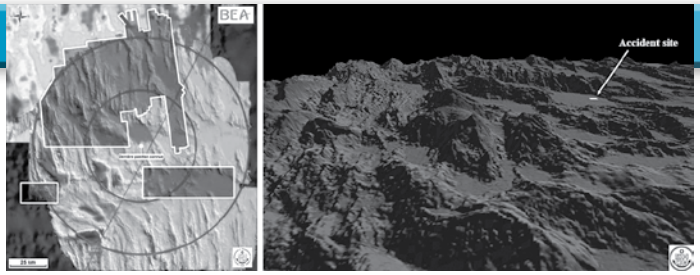

Figure 1: Bathymetry and accident site.

Figure 2: Phase 4 ship and equipment. The M/V *Alucia* (left) and the AUV REMUS 6000.

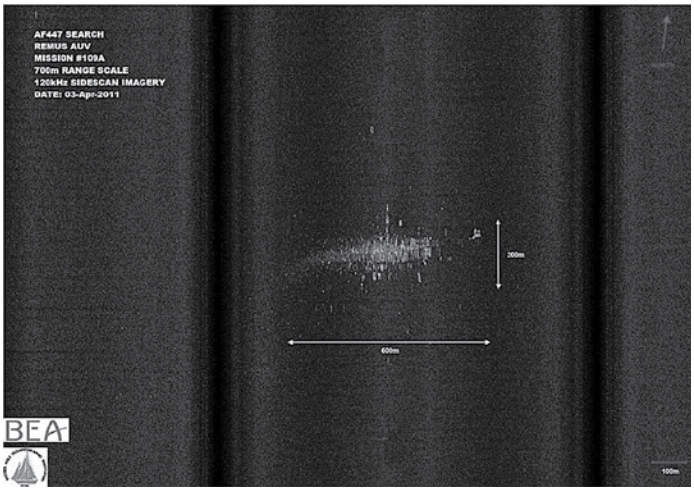

Figure 3: Sonar image of the bottom feature that was confirmed to be the wreckage area.

The Metron study[8], published on the BEA website on Jan. 20, 2011, indicated a strong possibility for discovery of the wreckage near the center of the circle. It was in this area that it was in fact discovered after one week of exploration, at a depth of 3,900 m 6.5 nm northeast of the LKP (see Figure 1).

II) Description of Phase 4 AUV operations

Phase 4 lasted on site from March 25 to April 9, 2011. During that phase, the REMUS 6000 AUVs were again used for the search. They were operated by WHOI from the Merchant Vessel *Alucia*, which was owned by Deep Ocean Expeditions (see Figure 2).

The REMUS 6000 AUV

The REMUS 6000 AUV has a length of approximately 4 m and a weight of approximately 880 kg. Each vehicle is deployed with

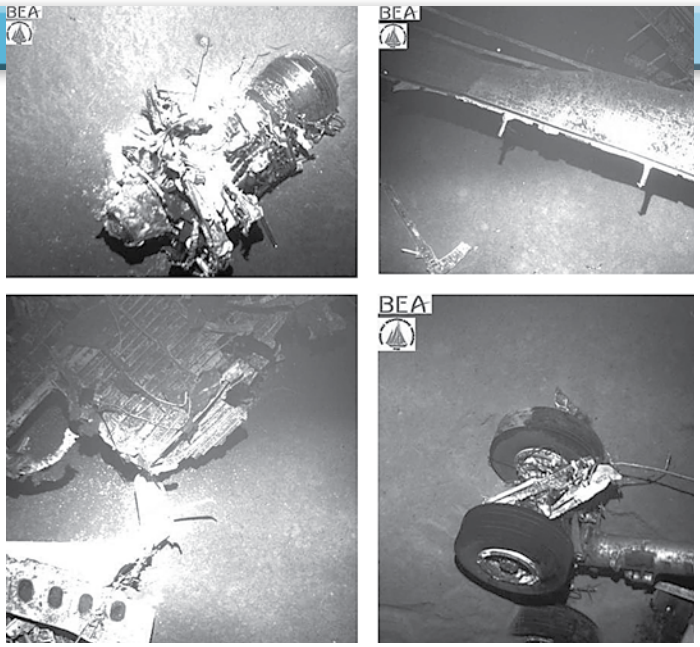

Figure 4: Selection of pictures taken by the REMUS on April 3, 2011. Clockwise from top left: engine, wing, fuselage panel, and landing gear.

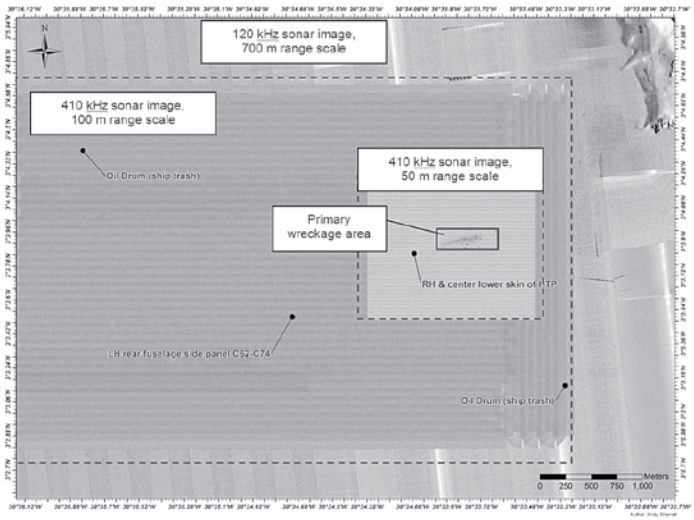

Figure 5: Superposition of sonar images obtained with various settings.

a lithium-ion battery capacity of 11 kW hours, which means that the mission time is between 20 and 24 hours. The normal operational speed in search mode is 3.5 kt (1.8 m/s). At this speed the vehicle can swim approximately 125 km. The primary search sensor is an Edgetech 120/410 dual-frequency non-simultaneous side-scan sonar. During a wide area search, the low frequency is operated at range settings of up to 700 m. In areas of rough terrain, the range is often reduced to 400 to 500 m in order to improve resolution.

The REMUS navigates using a combination of transponder-supported long baseline navigation and an ADCP[9] Doppler Velocity Log (DVL) enhanced inertial navigation. The long baseline is constituted of transponders with a frequency range of 8 to 12 kHz to provide position fixes when the REMUSs are operating near the seabed. Thanks to coded signals, multiple vehicles can navigate with a single pair of transponders. During operations, the REMUS is also acoustically tracked from the support vessel by using an acoustic ranging/communication system, which also provides REMUS status messages and allows redirection of a vehicle mission.

The REMUS is also equipped with an electronic still camera (ESC). This camera was extensively used at the accident site during Phase 4 as the conditions for photos were favorable with flat terrain and good underwater visibility. The photos were primarily taken from a distance of 9 to 11 m. During the initial ESC mission, the picture resolution was 1,024 pixels by 1,024 pixels. Based on lighting performance, the resolution was increased to 2,048 pixels by 2,048 pixels on subsequent missions. For the camera runs, the vehicle was slowed to 1.5 m/s, and pictures were taken every 4.5 m of travel over the sea floor.

Based on the experience gained during Phase 3, the REMUS 6000 AUVs were upgraded to improve terrain following thanks to enhanced capabilities. The new software version enabled climb/dive angles up to 40 degrees, and a new 300 kHz DVL increased altitude tracking from 90 m to 170 m above the seabed.

Discovery of the accident site

On April 2, the 18th AUV mission was recovered and the subsequent analysis of the side-scan data included a bottom feature showing a concentration of backscattered data over an area of 600 by 200 m (see Figure 3).

A mission was programmed to obtain high-frequency sonar images and ESC pictures of the feature. This mission was completed on April 3, and the pictures confirmed that the feature was the plane wreckage. Some of these pictures (see Figure 4) were published on the BEA website the next day.

The location was approximately 6.5 nm north-northeast from the last known position. Over the next six days, additional AUV missions were conducted to identify the extent of the wreckage field and obtain a complete photo record of the primary wreckage area.

This exploration made it possible to locate a fuselage panel approximately two km away from the central zone as well as other man-made objects, such as oil drums probably thrown over board by vessels in transit (see Figure 5). The initial imagery was subsequently enhanced by high-resolution 410 kHz sonar images at various range scales.

This sonar mapping of the accident area was completed by the REMUS during the same missions the ESC pictures were taken. The debris field was overflown several times along north-south and east-west search patterns. More than 85,000 pictures were taken to create a photo mosaic of the accident site (see Figure 6).

The data produced during Phase 4, especially the photo mosaic of the accident site, helped the BEA to save a considerable amount of time for the following phase. It was the first time that investigators had a complete two-dimensional representation of the crash site based on high-resolution side-scan sonar images and photos before the onsite intervention of an ROV. These aerial pictures were very useful both for preparing Phase 5 and conducting the survey of the site. Color imagery could have provided significant additional information and possibly identified the flight recorder components on the seafloor.

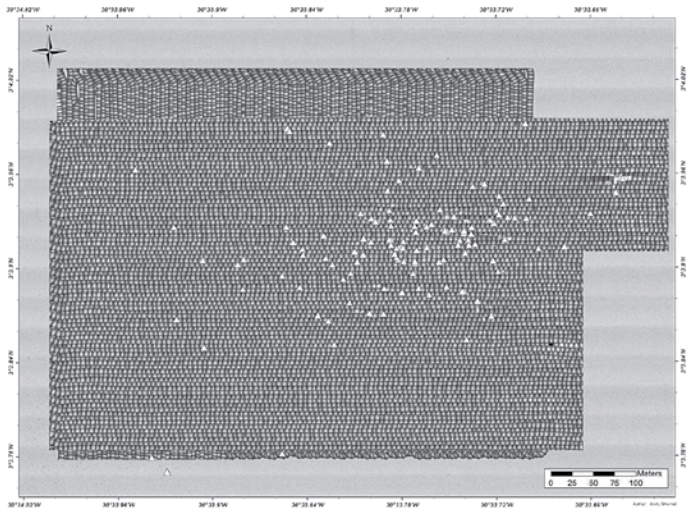

Figure 6: Photo mosaic obtained with REMUS ESC images and airplane parts identified by using the REMORA III ROV.

Fusion of ESC images

WHOI and the Waitt Institute have developed techniques using commercially available software programs to enable analysts to semi-automatically stitch and merge photos from the mosaic. The following example (see Figure 7) displays this fusion process on one of the largest debris field components. This type of image provided operators and investigators an accurate overview of the debris field and facilitated ROV mission preparation.

III) Preparation of Phase 5

Phase 5 was the recovery phase. Its preparation took place at the same time as the preparation of Phase 4, as the M/V *Alucia* had only search equipment on board and no recovery equipment. Phase 5 was dependant on the success of Phase 4. As soon as the wreckage was found, it was crucial to mobilize a support vessel with recovery equipment to be on site as quickly as possible. To do this, the BEA published an international call for tenders in the format of a framework agreement. The deadline for submissions was March 15, 2011. The contractor had to provide the following services: sea search operations, localization, and recovery of the aircraft recorders at a depth that may reach 6,000 m; submarine observation of the wreckage and charting the distribution of the debris that was identified as being relevant; recovering, preserving, and transporting pieces of the aircraft wreckage, and collecting any HR according to the possibilities provided by the handling instruments and the state of preservation of the remains.

Before the start of Phase 4, the BEA preselected three offers that met its technical criteria. They took into consideration the difficult environment and the remoteness of the accident site and were mainly based on ship storage capacity, ship and ROV lifting capacity, ROV maximum operating depth, and ROV maneuvering capabilities. It was also essential to anticipate having on board all the necessary equipment and procedures to decently deal with HR in case they were any and they had to be recovered. The psychological preparation of the operators dealing with HR recovery was another requirement specified by the BEA.

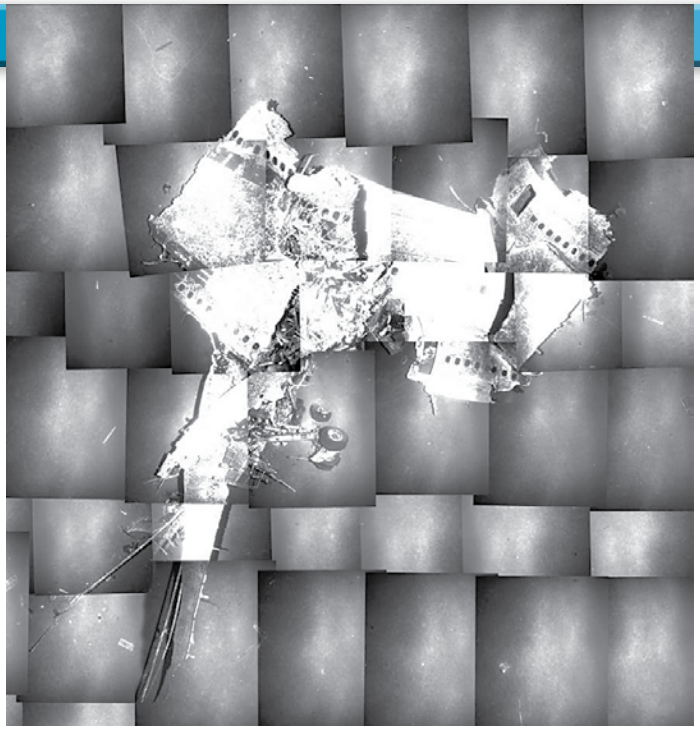

Figure 7: Example of the fusion process results.

Figure 8: Phase 5 ship and equipment. The C/V *Ile de Sein*, (left) and the ROV REMORA III.

When the wreckage was found, the BEA just had to select one of the three preselected vessels, mainly on the criteria of proximity to the accident site. That was done after a short consultation period with a deadline of April 7, 2011.

To undertake the fifth phase of maritime operations, the BEA ultimately selected the C/V *Ile de Sein* operated by Alcatel-Lucent and Louis-Dreyfus Armateurs (LDA), equipped with the REMORA III ROV from Phoenix International that can operate at maximum depth of 6,000 m.

IV) Organization of Phase 5 operations

Phase 5 was organized in two parts:

- The first part dealt with the search and the recovery of the two flight recorders as well as the recovery of airplane parts. It took place on site from April 26-May 13, 2011.
- The second part dealt with submarine observation of the wreckage, charting the distribution of the debris, and the recovery of human remains. These operations lasted on site from May 21-June 3, 2011.

The REMORA III ROV

The complete system is comprised of a vehicle, fiber optic cable and winch, a launch/recovery system, and operations and

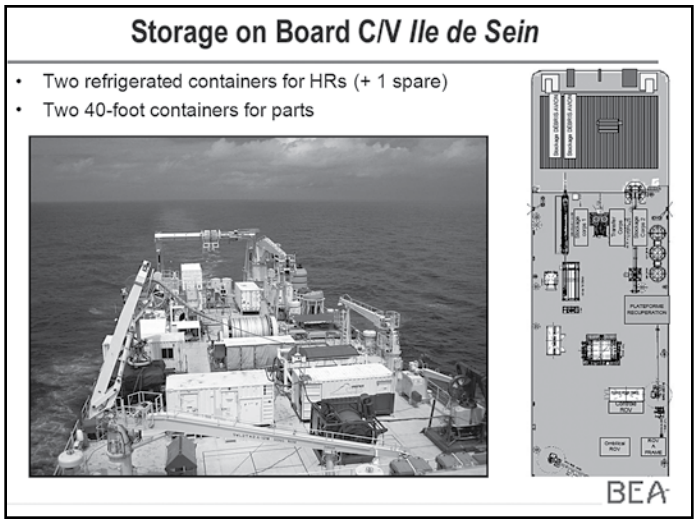

Figure 9: View of the upper deck (left) and layout of both decks (right).

maintenance vans. The REMORA's design strikes a balance between power and capability, meets a wide range of operational requirements, and is sized for air transport and rapid mobilization on vessels of opportunity anywhere in the world. This small and powerful vehicle has axial lateral thruster geometry that allows precisely controlled maneuvers in the tightest of spaces and minimizes the probability of entrapment or entanglement. Given the REMORA's size and weight, added benefits include lower transportation and support vessel costs. The REMORA was installed on the C/V *Ile de Sein* in Las Palmas, Canary Islands (see Figure 8).

The C/V Ile de Sein

The C/V *Ile de Sein* is about 140 m long and designed to carry a heavy ROV on its deck with its support equipment. It has an advanced dynamic positioning (DP II) system that allows it to precisely maintain position, even with unfavorable meteorological and sea conditions. This ship was been designed to lay cables on the seabed with a one-m precision, and its system for cable tension and run-out speed proved to be very useful for bringing to the surface large and heavy plane parts. It is the sister ship of the C/V *Ile de Batz,* which was used in 2004 for the successful recovery operation off Sharm el-Sheikh (Egypt) in the aftermath of the Flash Airlines B-37 accident.

The onboard facilities such as meeting rooms, cabins, and a restaurant made the C/V *Ile de Sein* a very effective vessel for a long mission on a remote site. The "test room" was set up to facilitate work on board for the investigative teams members who were working in close coordination with the ROV pilots through several video screens and the co-located Phoenix survey center. Being a large vessel, it could easily accommodate the installation of extra containers. The C/V *Ile de Sein* embarked with two 40-foot containers for parts on the lower deck (near the 50-ton A-frame) and three 20-foot refrigerated containers for storing HR on the upper deck. This included a spare in case one of the refrigerated containers malfunctioned (see Figure 9).

The C/V *Ile de Sein* was thus the support ship for the REMORA III ROV. The movements of the ROV and the ship were coordinated by the survey that was located on the *Ile de Sein's* bridge and the Phoenix survey center located in the test room.

USBL positioning system

Before the onsite mission, a new Ultra-Short BaseLine (USBL) acoustic positioning system was installed in Las Palmas on the *Ile de Sein's* through-hull deployment pole. The Sonardyne Ranger 2 USBL system was designed for deep-water, long-range tracking of underwater targets and position referencing for dynamically positioned (DP) vessels. The system calculates the position of a subsea target by measuring the range and bearing from the vessel-mounted transceiver to acoustic transponders fitted to the ROV, the recovery baskets, and the lift lines. This system was integrated with the ROV REMORA III survey system. It made it possible to reach system accuracy of 0.1% of slant range under the best sea conditions. Having accurate underwater positioning has always been a challenge and subject to the sea environment. Indeed, acoustic waves are used for USBL systems in liquid environments, and their propagation depends on various linked parameters such as salinity, water temperature, and depth.

Underwater navigation performance

The operation of the new positioning system used in combination with Phase 4 data proved to be extremely helpful. The side-scan sonar maps and the photo mosaic were geo-referenced on the ROV's navigation system. When acoustic transmissions were perturbed, the ROV pilots could still navigate with high accuracy as they had at their disposal the REMUS two-dimensional pictures. Thus, Phoenix International used the frog-leaping technique to visually navigate from one debris component to the next. A range and bearing were given by the survey to the ROV operators so that they could find with a precision of one m each debris component or HR displayed by the REMUS images.

The survey center could also display the two-dimensional photo of the target to the ROV pilots as they had the third dimension in real time through their ROV cameras. All sizeable items of debris were thus systematically searched for and identified during the mapping of the wreckage site.

Figure 10: Debris scattered on the seafloor.

Discovery and recovery of the flight recorders

When the accident site was discovered, it was observed that, apart for some large debris, the airplane was very fragmented. The small size of the flight recorders represented a challenge to overcome given the shear number of items of debris scattered on the sea floor, as shown in Figure 10.

During the first ROV dive, the chassis of the airplane's flight data recorder (FDR) was found, though without the crash survivable memory unit (CSMU) that contains the data. It was surrounded by debris from other parts of the airplane. The forward and aft parts of the airplane were broken apart and mixed up, which meant that a time-consuming, systematic search was required.

On May 1, 2011, the investigation team localized and identified the memory unit from the FDR. It was raised and lifted on board the C/V *Ile de Sein* by the REMORA 6000 ROV the same day. The next day, the cockpit voice recorder (CVR) was localized and identified. It was raised and lifted on board the *Ile de Sein* on Tuesday, May 3, 2011. The flight recorders were first transferred to the port of Cayenne by the French Navy patrol boat *La Capricieuse* and then transported to the BEA by plane on May 12, 2011.

During that period, the recovery of airplane parts continued, with one engine and the avionics bay, containing onboard computers, being raised.

Wreckage mapping

The REMORA capabilities and the lifting equipment from the C/V *Ile de Sein* were jointly used to move and recover airplane debris. The REMORA "pan and tilt" camera and especially the skills of the Phoenix operators enabled investigators to read most part number references of numerous items of debris in order to precisely identify the debris scattered at the bottom of the ocean. A geo-referenced database was created and a complete mapping of the wreckage site was achieved. Figure 11 illustrates the main wreckage parts that were identified.

HR and psychological aspects

The second part of Phase 5 mainly dealt with HR recovery. The retrieval of any bodies and personal effects was placed under the responsibility of the representatives of the judicial authorities. A dual sweep of the accident site had thus been undertaken by both teams to comprehensively map the wreckage distribution and at the same time ensure that all HR were recovered.

The recovery of HR is an operation that cannot be improvised. Material preparation and space to process the remains in good conditions are crucial. The crew of the C/V *Ile de Sein* provided all the necessary logistical assistance to the forensic team members, who had space and a secured work station to perform their tasks with serenity, decency, and discretion. The ROV operators managed to unbuckle seatbelts and extract bodies from the wreckage with outstanding skills.

A psychiatrist and a psychologist were also on board the C/V *Ile de Sein*. Their presence was greatly appreciated by all those on board. It also demonstrated a strong involvement of management for the performance of that unusual job, which was to

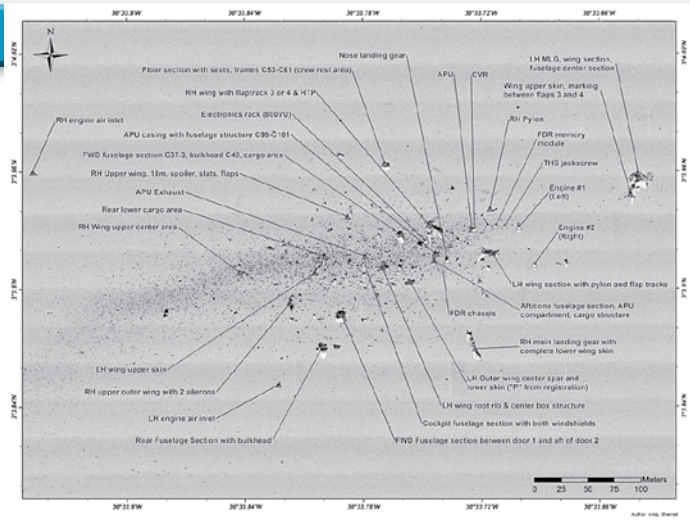

Figure 11: Mapping of the main airplane parts.

recover HR nonstop for two weeks. The medico-psychological support was adapted to each stage of the mission through preparatory briefings during the transit to site, possibilities of having defusing moments during or just after basket recoveries, and debriefing during the return transit.

The lessons learned from previous operations were implemented in that delicate mission, which went very well. The initial survey showed that nobody suffered any post traumatic syndrome disorder (PTSD) after that mission. Psychological follow-up has been offered to all persons aboard the C/V *Ile de Sein*.

V) Summary—lessons learned

Financial summary

The following table (see Figure 12) summarizes the AF Flight 447 search and recovery costs and the number of days spent onsite until each phase. The costs of the search and rescue (SAR) operation were borne by the Brazilian and French armed forces. Other states also participated in these SAR missions. Although it is difficult to estimate the costs of these surface searches that lasted until June 26, 2009, roughly 80 million Euros is a reasonable assessment made by specialists.

On the other hand, the costs encountered for the underwater operations are better known. The first two phases cost the BEA 10 million Euros. The Phase 3 budget was estimated at 13 million Euros for the two parts. For that phase, a special common fund was created by the BEA. Airbus and Air France

Surface search	**June 2009**	**26 days**	**€80 million** (estimated for information)
Phase 1	June/July 2009	30 days	10 M €
Phase 2	August 2009	22 days	
Phase 3	April/May 2010	52 days	11.6 M €
Phase 4	March/April 2011	15 days	7 M €
Phase 5	April-May 2011	31 days	6 M €
TOTAL Phases 1-5 (on site)		**176 days**	**€ 34.6 million** (estimate)

Figure 12: Costs and duration of the sea search operations.

contributed equally to that fund. At the end of Phase 3, 1.4 million Euros we've returned to the contributors. It is worth noting that sea search operation costs are dependent on fuel prices and the Euro/U.S. dollar exchange rate, which are two difficult variables to predict. Phase 4 was directly paid for by industry under the framework of a memorandum of understanding among Airbus, Air France, the BEA, and WHOI. Phase 5 was directly financed by the BEA.

Lessons learned and recommendations

The initial negative search results triggered some lessons learned in order to facilitate the localization of wreckage lost at sea. The BEA's Interim Report No. 2 on the AF Flight 447 accident included two safety recommendations addressed to ICAO and EASA on ULBs:

- The first one recommended that ULB transmission time should be increased to 90 days, which would have made it possible to prolong the search for the ULB beacons in this vast zone.
- The second one pointed out that the current 37.5 kHz ULB beacons have a limited range, which means that specific equipment, not very widely available, must be used for depths greater than 1,500 m. The use of beacons transmitting at lower frequencies (for example, between 8.5 and 9.5 kHz) would have made it much easier to detect the wreckage, because they carry further. In addition, most navies in the world are equipped to detect these low-frequency signals.

Regarding the acoustic searches undertaken during Phase 1, it is worth noting that although the TPL position data were recorded, this was not the case for acoustic raw data. The use in deferred time of post-treatment software could have been helpful to check whether ULB signals were audible in the surrounding noise. For future passive acoustic search systems, it would be worth

- recording this type of search data. Some of this feedback and other BEA safety recommendations have already been taken on board by regulators and industry in order to ultimately improve safety through improving the effectiveness of investigations.

AF Flight 447 reported its position every 10 minutes. In the absence of any radar data, this proved to be useful, but the search circle represented a vast area of 17,000 km^2.

- More frequent position reporting by airplanes is an easy modification to implement in the short term to avoid long and expensive searches.

Based on the results of a BEA-led international working group (the Triggered Transmission of Flight Data WG[10]), the BEA published two additional recommendations in its Interim Report No. 3. It suggests making it mandatory for airplanes performing public transport flight on long-haul flights over water to trigger the transmission of flight parameters to help the localization of the wreckage or to activate the Emergency Locator Transmitter (ELT) in case an emergency situation is detected in flight.

In addition, the work performed on reverse-drift simulations showed that

- the dropping of drift-measurement buoys by the first aircraft to arrive over the zone would have made it possible to understand the drift better from the earliest hours.

Conclusions

The successful recovery of both flight recorders was a major step for the BEA safety investigation. These search efforts to find the wreckage and solve the enigma of the Rio-Paris flight have required wide-ranging international cooperation in which

- WHOI played a key role in the successful location of the wreckage, and
- Phoenix International was instrumental in the search and recovery of the two flight recorders.

It was first a race against time to operate the acoustic detection devices (TPLs) while the beacons were still transmitting. It then became a very complex operation for the preparation of the subsequent phases when time was less of a factor. The BEA has been fortunate to benefit from the assistance of international partners coming from specialized fields that go beyond the domain of aviation (such as space, oceanography, marine, mathematics). The scientific tools provided by Metron enabled assessment of all previous search results with a rational approach based on probability maps. The Metron study indicated a strong possibility for discovery of the wreckage near the center of the circle, which is where it was actually discovered one week after the beginning of Phase 4.

The financial commitment of the BEA, Air France, and Airbus to keep searching for the missing airplane illustrated the strong desire of the aviation sector to explain all accidents as completely as possible in order to prevent their recurrence.

Finally, the numerous lessons learned after these search efforts that involved governments and industry will lead to the development of new methodologies and improvement of tools for acoustic searches in both passive (towed pinger locators) and active (side-scan sonars) modes. It is hoped that the lessons learned and the safety recommendations released by the BEA during that process will first prevent the recurrence of the AF Flight 447 accident, and in case of accidents at sea, prevent future similar complex and challenging sea search operations. ◆

Endnotes

1 Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile–E-mail: olivier.ferrante@bea-fr.org.
2 Phoenix International, Inc.–E-mail: mkutzleb@phnx-international.com.
3 Woods Hole Oceanographic Institution–E-mail: mpurcell@whoi.edu.
4 The U.S. Navy's TPLs are the two only towed hydrophones in the world that can operate at up to a depth of 6,000 m.
5 Two REMUS 6000 AUV belonged to the Waitt Institute for Discovery (WID) and one to IFM GEOMAR, the German oceanographic institute. All three vehicles were manufactured by Hydroid, a wholly owned subsidiary of Kongsberg Maritime.
6 The SLDMB (Self Locating Data Marking Buoy) buoy developed by METOCEAN (Canada) is equipped with lateral fabric panels that act as a floating anchor. It transmits its GPS position via the ARGOS system that transfers the data by satellite.
7 Metron was involved in the development of the U.S. Coast Guard's SAROPS (Search and Rescue Optimal Planning System) software, which has been successfully employed to plan and execute searches for ships and personnel lost at sea. For the AF Flight 447 search, Metron used a modified version of SAROPS in order to model distribution of particles. Each particle (up to 10,000) was assigned a path and a "weight" coefficient, which gave a probability figure to each one of them.
8 Search analysis for the location of the AF Flight 447 underwater wreckage, at http://www.bea.aero/fr/enquetes/vol.af.447/metron.search.analysis.pdf.
9 ADCP (Acoustic Doppler Current Profiler): Device to measure underwater current and vehicle speed over the seafloor.
10 See http://www.bea.aero/en/enquetes/flight.af.447/triggered.transmission.of.flight.data.pdf.

ISASI 2012 Readies Agenda, Issues Call for Papers

ISASI's 43rd annual seminar to be held in Baltimore, Md., USA, Aug. 27–30, 2012, is issuing its "Call for Papers." Papers are invited that would benefit an international audience and that address the theme of the seminar: "Reactive to Predictive." Topics may address the historical evolution from reactive to predictive; the interaction between accident or incident investigation and accident prevention or analysis; analytical processes that identify, monitor, or assess emerging risks; the practical application of those processes to minimize the risk of accidents; or other topics related to investigative or analytical methods, issues, or past findings. Topics may address any segment of the air carrier industry or general aviation.

An expression of interest in delivering a paper should be sent by e-mail no later than Feb. 3, 2012, to isasi.baltimorepaper@yahoo.com. Please include a working title for your paper, plus your name, affiliation, and position.

Abstracts must be submitted by e-mail by March 2, 2012, to be considered by the Selection Committee. The Committee will invite final papers and presentations from selected abstracts.

E. MARTINEZ

Candy Del Gandio accepts from Richard Stone the "ISASI gong," which is used to summon seminar attendees back into session after breaks. The passing is a tradition that closes the awards banquet of any given annual seminar.

Please limit abstracts to a maximum of 300 words.

Only e-mail submissions will be considered. If your proposal is selected for presentation, you will be advised by e-mail no later than April 5, 2012. Final papers must be submitted by July 6, 2012.

Committee members for the seminar are Frank Del Gandio, Seminar chair; Robert Matthews, Technical Committee chair; Ron Schleede, Sponsorship chair; and Candy Del Gandio, Companion Program chair.

Two tutorials are planned for the seminar's first day. Anna Cushman of the FAA will present "When Animation Doesn't Tell the Real Story…Flight Data Recorders for Accident Investigation and Beyond." Andy McMinn of TSI will present "Basic Failure Analyses: Failure Mode Identification at the Accident Site."

The annual event will be held at the Baltimore Marriott Waterfront, which sits on the water's edge in Baltimore's Inner Harbor. In addition to outstanding conference facilities, the 732-room hotel offers spectacular views and easy access to the city's finest shopping and restaurants. Choose from more than 50 dining options within a few blocks of the hotel or explore the National Aquarium, the Maryland Science Center, and more. The rooms come with full amenities, which include a 37" HDTV, wired and wireless Internet access, and a plug-in panel to connect laptops and digital cameras. Seminar room rates are US$159 per night. Both seminar and hotel registration information can be found on the ISASI 2012 website. ◆

ESASI Sets 2012 Seminar

The European Society of Air Safety Investigators will conduct its 5th air safety seminar on April 19–20 in Amsterdam, the Netherlands, announced ESASI Councillor Anne Evans. She noted that emphasis "will be on current European issues in the investigation and prevention of accidents and incidents." The two-day seminar is aimed at accident investigation professionals and will provide an opportunity to update professional knowledge and skills, as well as to meet other active air safety investigators.

With a seminar theme of "Air Accident Investigation in the European Environment," technical presentations will address current issues in the European environment and the challenges of modern air safety investigations. The program will take place at the Dutch National Aerospace Laboratory (NLR), which is the key center of expertise for aerospace technology in the Netherlands. Hotel accommodation will be arranged in the city center and transport provided to the NLR.

Amsterdam has been called the "Venice of the North" for its more than one hundred kilometers of canals, about 90 islands, and 1,500 bridges. The seminar program will include an evening reception with a dinner cruise on the canals, providing a unique perspective on the city. Companions are welcome to attend the dinner cruise.

Details are available on the ESASI website, www.esasi.eu. For bookings, contact ESASI Councillor Anne Evans, Tel: =44(0)7860516763 or e-mail: anne_evans@hotmail.com; or ESASI Secretary John Dunne, Tel: +44 (0) 7860 222266 or e-mail: john.dunne888@gmail.com. ◆

ISASI San Francisco Chapter Conducts Roundtable Talk

"Investigating a Major Aviation Accident" was the topic of the roundtable discussion that the San Francisco Chapter held on October 28 at the Oakland Aviation Museum, Oakland Airport, California.

Featured speakers included Ron

Schleede, who was employed at the NTSB for more than 28 years as a field investigator, human factors investigator, and manager of major investigations. He is also the 2002 ISASI Jerry Lederer Award recipient. He was joined by the 2001 Lederer Award winner John Purvis. John retired after a 41-year career with the Boeing Commercial Airplane Company. He served as its director of air safety investigation for 17 years. Also participating was Toby Carroll, director of flight safety for Continental Airlines. Toby has led Continental's Flight Safety Department for more than 25 years and serves as president of the U.S. Society of ISASI. ◆

Nominations Open for 2012 Executive Election

Nominations for election to the ISASI offices of president, vice president, secretary, treasurer, U.S. councillor, and international councillor for the term 2012-2014 are now being accepted by Troy Jackson, the recently appointed ISASI Nominating Committee chair who succeeded Tom McCarthy.

Outlining the nomination procedure, Troy notes that all nominees must be at least a full member in good standing to be eligible for office within ISASI. He adds that each potential candidate whose name is submitted to the Nominating Committee must have consented to the submission and that the nominator must submit a short biographical sketch of the nominee. Nominations should be sent no later than April 1, 2012, to Troy Jackson, 1512 N. Lilac Terr, Mustang, OK, USA, 73064 or e-mail: troy.airsafety@gmail.com.

Troy is a senior air safety investigator with the National Aircraft Accident Investigation School at the U.S. Department of Transportation, Transportation Safety Institute. He is the course manager for advanced aircraft accident

Troy Jackson

investigation, general aviation accident investigation, commercial aviation accident investigation, and internal evaluation programs. He serves as a senior instructor in safety management systems and human factors. In addition, Troy is a retired U.S. Air Force pilot who performed duties as a safety officer, accident investigator, and instructor pilot. He holds an FAA air transport pilot (ATP) rating. He is a graduate of the U.S. Air Force Academy, University of Oklahoma, and Indiana University. Most recently, he conducted a tutorial at ISASI 2011. ◆

Southeast Regional Chapter Names New Chapter Officers

Robert Rendzio, president of the Southeast Regional Chapter (SERC), announced that Dan McCune, who was treasurer, is now SERC vice president. Alicia Storey is now the SERC treasurer and is responsible for monitoring all expenses, reporting to the SERC on expenditures, writing checks on behalf of the SERC, and assisting with annual events.

Rendzio reported that the Chapter sponsored two Chapter students to ISASI 2012 held in Salt Lake City, Utah, by providing air travel and hotel accommodations. He urged Chapter members to also assist in enabling student members to attend. In all, 17 students attended ISASI's annual seminar.

Robert announced the proposed establishment of a Chapter student outreach program, naming Anthony Brickhouse as the SERC outreach coordinator for student activities. Anthony's function is to increase the number of students who actively participate in aircraft accident investigation and their activities within both the SERC and ISASI. Robert said, "It is a position that has not been formally identified, but I and vice president Dan McCune feel that we would all benefit from its purpose. With that said, we will develop an amendment to the SERC by-laws and charter for consideration and member approval. Until that time, [Anthony] will function in that position unless there are problematic issues that have not been seen thus far."

Robert noted that preparations are well under way for the SERC annual meeting, which will be held in New Orleans, La., on March 17, 2012, at the Maison Dupuy Hotel. To register for the event, contact Alicia Storey at 334-598-8893 or e-mail astorey@srca.net. To make reservations at the hotel, call 1-800-535-9177 and ask for the ISASI group rate. ◆

Unmanned Aircraft System Working Group Meets

The first meeting of the ISASI Unmanned Aircraft System (UAS) Working Group (WG) was held in conjunction with ISASI's annual seminar on September 14. About 24 members participated. WG Chair Tom Farrier discussed the Terms of Reference approved by the International Council, which sets forth the following tasks:

- Determine properties of unmanned aircraft systems and their operations that differ from existing aircraft.
- Identify additional investigative capabilities that may need to be developed or made more robust to support the investigation of UAS-involved accidents.

For Annex 13 to the Convention on International Civil Aviation, Aircraft Accident and Incident Investigation:

- Determine the extent to which Annex 13 definitions for the states of design,

Continued . . .

manufacture, occurrence, registry, and the operator can be applied to unmanned aircraft systems, including their ground- and satellite-based components.
- Assess the adequacy of current guidance regarding determination of the state responsible for conducting the investigation of a UAS accident.
- Document any need to recommend changes to Annex 13 related to the above.
- Identify a standard dataset that should be captured for each UAS-involved accident.
- Identify additional UAS-specific training requirements for air safety investigators based on the above.
- Identify additional regulations that may be needed to create or preserve evidence relevant to UAS accidents.
- Make recommendations to the ISASI Council regarding the best means of addressing the above to other ISASI committees and working groups for appropriate action.

In addition to the above, Tom reports that Marcus Costa, chief of ICAO's Accident Investigation Section, has asked the WG to support a planned update to ICAO Document 9756, Manual of Accident and Incident Investigations, with high-level guidelines for UAS accident investigations. Participants have been invited to volunteer to work on one or more of these tasks. Work will be coordinated by e-mail (and possibly teleconferences) until next year's annual seminar. ◆

AsiaSASI Sets 2nd Term Officers

The Asian Society of Air Safety Investigators (AsiaSASI), which was formed in 2009, held elections for the second term of officials in July. The current office incumbents have been re-elected for the next term, which began on September 4. They will hold office for another two years.

E. MARTINEZ

Chairman Farrier discusses the Terms of Reference with his UAS group during ISASI 2011.

The re-elected members are president—Civil Aviation Department of Hong Kong, represented by Norman Lo, chief inspector of accidents; vice president—Japan Transport Safety Board, represented by Ikuo Takagi, investigator-general for aircraft accident; and secretary—Air Accident Investigation Bureau of Singapore, represented by Chan Wing Keong, director. ◆

ISASI Membership, A Valued Connection

Last August the ISASI international office received an application for reinstatement of membership from a member in England who had not renewed his membership during a renewal period. He took advantage of the reinstatement policy that reads "Qualifications: 3.9… Any member whose name has been removed from the rolls because of failure to pay dues may, at the discretion of the Council, upon written application and the payment of all financial obligations due to ISASI, be considered for reinstatement to membership in accordance with Article 111 of the Bylaws."

On the application form, he wrote: "To Whom It May Concern. Failure to renew my membership has made me realize how valuable ISASI is in keeping me abreast of aviation news. It is therefore requested that my membership be reinstated as soon as practicable. Thank you."

ISASI membership renewal notices are in the mail and on their way to you. Membership Chairman Tom McCarthy says, "It's easy to set the notice aside and then forget to give it attention. So, this year think about that 'connection' ISASI gives you. Complete the renewal when you receive it, mail it, then be comfortable for another year."

The renewal notice invoice covers the period Jan. 1-Dec. 31, 2012. Remember to check individual identification information and update it, if necessary. Also, don't overlook the deadline for ISASI receipt of payment, Jan. 31, 2012. Payment by credit card is available. Late payments incur a $20 fee. Checks should be made payable to ISASI and forwarded to ISASI, 107 E. Holly Avenue, Suite 11, Sterling, VA, USA. ◆

ASASI Reports Member Farrar 'Flies West'

ISASI's Australian Society reports that Mark Farrar, a society member, passed away on May 8 at age 52. Mark was manager of emergency and contingency planning at Sydney Airport Corporation Limited at his passing. He had been with the Sydney Airport in various capacities since 1998. He was respected by his work colleagues and the airport management for his enduring dedication and passion for safe operations and practices. Education was Mark's focus as a preferred method for ensuring the message was being passed on that complacency and ignorance were no excuse in the event of an aviation occurrence. His role and responsibility were to facilitate the effective involvement of all services that would be involved in the event of a serious incident or accident at Sydney Airport.

ASASI President Lindsay Naylor said of Mark, "Mark was always willing to

NEW MEMBERS

CORPORATE

FedEx Express
Charles J. Pearson
Stuart E. Bothwell
National Institute of Aviation Safety and Services, New Delhi, India
Arun K. Chopra
Mahender S. Borra

INDIVIDUAL

Allen, Michael, J., Del Rio, TX, USA
An, Jerry, G., Prescott, AZ, USA
Anderson, William (Bill), A., Mooresville, IN, USA
Barroso Vitar, Jorge, E., Madrid, Spain
Bartley, Jennifer, A., Salt Lake City, UT, USA
Bastek, Ian, A., Mobile, AL, USA
Beavan, Sharon, M., Falls Church, VA, USA
Bertish, Shane, D., Washington, DC, USA
Blair, Kenneth, B., Sale, United Kingdom
Bolanos, Mark, Los Angeles, CA, USA
Clark, Lori, D., Lolo, MT, USA
Cohen, Michael, H., Toronto, ON, Canada
Denning, Jeremy, R., Mobile, AL, USA
Diercksmeier, Jeffrey, C., Costa Mesa, CA, USA
Fields, Joseph, B., Port Orange, FL, USA
Ford, Sammy, J., Tulsa, OK, USA
Frew, Derek, J., Vincentia, NSW, Australia
Gentile, Anna, 07026 Olbia, Italy
Gibbs, Lisa, A., Humacao, PR, USA
Gray, Nicole, M., Jerrabomberra, NSW, Australia
Griffith, M.D., J. Samuel, Ozark, AL, USA
Gunn, David, J., Glenbrook, NSW, Australia
Hansen, Ian, A., Lake Oswego, OR, USA
Harris, Christopher, P., Fresno, CA, USA
Henry, Geoffrey, K., San Marcos, CA, USA
Hood, Alexander, C., Braddon, ACT, Australia
Hutton, Mark, E., Las Vegas, NV, USA
Joly, Paul, A., Henderson, NV, USA
Keyes, Christopher, H., Oklahoma City, OK, USA
Kikuchi, Guillermo, C., Capital Federal, Argentina
Koenes, Michael, W., Castle Rock, CO, USA
Linn, Ronald, D., Eagan, MN, USA
Luna Victoria Quevedo, Juan Carlos, Lima 18, Peru
Mard, Christopher, A., Cape Neddick, ME, USA
Martin-Chico, F. Javier, Madrid, Spain 28221
Micolta, Camilo, Bogota, Colombia
Morgan, Gary, E., Wellford, SC, USA
Morris, Steven, L., Colorado Springs, CO, USA
Mulloy, Stephen, P., Great Falls, VA, USA
Nesthus, Thomas, E., Edmond, OK, USA
O'Connell, Patrick, J., Dublin 9, Ireland
O'Toole, John, L., County Westmeath, Ireland
Personett, Joseph, A., Monument, CO, USA
Peterson, Michael, A., Hereford, AZ, USA
Rauch, Stephen, Caldwell, ID, USA
Rooney, Larry, J. Doylestown, PA, USA
Rossi, Rudy, J., Caldwell, ID, USA
Rutkowski, Randal, J., Soquel, CA, USA
Stack, Robert, O., Bloomingdale, IL, USA
Stipetich, John, A., Houston, TX, USA
Sylvestre, Daniel, J., St. Jean sur Richelieu, QC, Canada
Thomas, Brian, S., Norfolk, NE, USA
Todd, Melanie, A., Dunlop, ACT, Australia
Tomkins, Stephen, E., Cherrybrook, NSW, Australia
Toms, Jerry, L., Liberty, NC, USA
Van Der Syde, Carl, C., Terrigal, NSW, Australia
Ventura, Filippo, Buochs, NW, Switzerland
Ward, Mark, D., Woodstock, GA, USA
Westmoreland, William, D., Hillsboro, OR, USA
Wetstein, Ben, C., Anchorage, AK, USA
Zayko, Sergey, Moscow, Russia
Zwegers, David, H., Port

provide whatever assistance he could. His work at Sydney International Airport in recent years made him eminently qualified to help other airports that sought assistance. He was a long-serving member of ISASI and ASASI, and he is sadly missed. ◆

Recent NTSB, FAA Appointments

Deborah Hersman was officially sworn in on August 4 for a second two-year term as NTSB chairman. She became chairman on July 28, 2009. She was nominated for the second term by President Barack Obama on June 28, 2011, and confirmed by the U.S. Senate on August 2. Her term as chairman ends on Aug. 3, 2013. She is concurrently serving a second five-year term as Board member, which runs through Dec. 31, 2013.

On August 25, Christopher Hart was sworn in for his second two-year term as NTSB vice chairman. Hart's term as vice chairman ends on Aug. 24, 2013. He is concurrently serving a five-year term as Board member, which runs through Dec. 31, 2012. Vice Chairman Hart had previously served as an NTSB Board member from 1990 to 1993.

Preceding the NTSB actions, FAA Administrator Randy Babbitt announced in July that David Grizzle will be the chief operating officer of the FAA's Air Traffic Organization. "David is committed to transparency, accountability, and to building a safety culture that encourages collaboration. I am thrilled that he has agreed to accept this critical responsibility," said Babbitt. Grizzle, who became FAA's chief counsel in 2009, has been filling the role of chief operating officer since mid-April. Before joining the FAA, he worked with Continental Airlines and its affiliates for 22 years. As chief operating officer, he is responsible for leading the FAA's 35,000 air traffic controllers, technicians, engineers, and support personnel who keep the nation's air traffic system moving safely. ◆

PHOTOS: E. MARTINEZ

Corporate members that join ISASI during the year are awarded their recognition plaques at the annual seminar. Shown receiving their corporate plaque from President Frank Del Gandio are, left, Michael Smith of Military Air Accident Investigation Branch, UK, and (2nd photo) Capt. Rilo Raja of PT. Merpati Nusantara Airlines (Jakarta).

Airplane Plus Heat Plus Ice Equals Mystery

(The following is excerpted from an article by NASA's Jim Banke with the Aeronautics Research Mission Directorate. It deals with a phenomenon that many people may not be familiar with.)

It's difficult to believe that an airplane flying in the tropics in the summer could have an engine fill up with ice, freeze, and shut down. But the phenomenon, known as engine core ice accretion, has happened more than 150 times since 1988, frequently enough to attract the attention of NASA aviation safety experts, who are preparing a flight

ISASI Roundup

Continued . . .

campaign in northern Australia to learn more about this occasional hazard and what can be done to prevent it.

"It's not happening in one particular type of engine, and it's not happening on one particular type of airframe," said Tom Ratvasky, an icing flight research engineer at NASA's Glenn Research Center in Cleveland. "The problem can be found on aircraft as big as large commercial airliners, all the way down to business-sized jet aircraft." And it has happened at altitudes up to 41,000 feet.

Little is understood about ice crystal properties at high altitude and how ice accumulates inside engines. The prevailing theory holds that the trouble occurs around tropical storms in which strong convection currents move moist air from low altitudes to high altitudes where the local temperatures are very cold, creating high concentrations of ice crystals. But the properties of the ice crystals, such as their size and how many of them are in a given volume of air, are a mystery, one that an international research team led by NASA aims to solve.

The FAA has proposed new certification standards for engines that will be operated in atmospheric conditions that generate ice crystals. The rules will take effect next year, just as the NASA team heads to Darwin, Australia, aboard an aircraft specially equipped with instruments to study cloud physics during the southern hemisphere summer. Analyses of the Darwin flight tests and additional tests in ground-based facilities in the United States and Canada will provide the FAA the means for ensuring compliance with the new standards.

For the flight research, NASA is outfitting a Gulfstream 2 business jet with more than 20 meteorological sensors that will be used to probe cloud properties, such as water content and the size and concentration of ice particles, which can lead to engine and air data sensor failures that threaten aviation safety.

The full article can be found at http://www.spacedaily.com/reports/Airplane_Plus_Heat_Plus_Ice_Equals_Mystery_999.html. ◆

Investigation—A Shared Process, *continued from page 11*

bolic scholarship plaque from President Del Gandio who labeled them "tomorrow's leaders of aviation."

The two also helped judge the technical paper competition to identify the winner of the Society's Award of Excellence for Best Seminar Paper. This year that award went to Olivier Ferrante, Bureau d'Enquêtes et d'Analyses, France; Michael Kutzieb, Phoenix International; and Michael Purcell, Woods Hole Oceanographic Institution for their paper titled Air France 447 Underwater Search and Recovery Operations—A Shared Government-Industry Process (see page 18.) The Excellence selection carries a US$500 prize. The authors contributed the $500 to the ISASI Rudolph Kapustin Memorial Scholarship Fund. In making the award presentation, the only surprise presentation of the event, President Del Gandio said, "It is truly an outstanding paper. I know what they went through. It was an arduous operation pulling that aircraft from the bottom. Again, thanks, not only for a great paper, but for a great job." The assembly agreed, as was evident by the very loud and long applause that ensued.

Robert MacIntosh also received verbal tribute for the many years he dedicated to aviation-safety-related activities. His retirement from the NTSB became effective at the end of September. As chief advisor of international safety affairs to the NTSB chairman, he was responsible for the overall management of the Safety Board's international safety program. As such, MacIntosh was well known to the ISASI members. In departing, he said, "Our association with ISASI and all others has been a great, great gift and a fantastic camaraderie. Thank you."

President Del Gandio then said, "This is the time when we give away the coveted Jerry Lederer Award (see page 12)." Peer recognition is, if nothing else, very loud. That was the scene as Paul-Louis (Paul) Arslanian, former head of the BEA walked forward to the front platform. Before tracing Paul's professional career from his posts with the Direction Générale de l'Aviation Civile (DGAC), for which he worked for 17 years, to and through his 19 years as head of the BEA, Del Gandio paused and told the crowd that because Paul reached the French civil service retirement age in October 2009, he retired.

He continued, "Paul has been a strong

President's View, *continued from page 4*

- 22 fatalities and no survivors on an SF34 operated by Argentina's Sol Lineas Aereas,
- 23 fatalities, including 14 on the ground, when an AN-12 operated by TransAir Congo crashed on takeoff,
- 12 fatalities among 15 occupants on a B-737-200 operated by Canada's First Air, and
- 3 fatalities and dozens of injuries among 124 occupants when a Tupolev 154 operated by Russia's Kolavia had a fire at engine start up.

This list could add some fatal accidents involving cargo operators and smaller regional aircraft, and we could add still more non-fatal but high-risk accidents. However, I think this list makes the point. We do not yet have the luxury of becoming the "Maytag repairman"; we still face plenty of challenges.

As we face those challenges this year and in the future, the idea captured by this year's theme of a shared process will be critical if we hope to continue reducing the world's accident rate. This will be especially true in regions that continue to suffer high accident rates.

As I do every year, I encourage you to participate actively in this seminar. If you are a student or if you have only recently joined the profession, take advantage of the wealth of aviation knowledge that is in this room. To our more experienced members here, I urge you to share your experience and your knowledge with your colleagues, but do not be reluctant to continue learning still more from those same colleagues.

Sharing our knowledge about investigative techniques, analytical methodologies, and aviation safety in general has always been the primary purpose of ISASI seminars. I urge everyone to share, but also to absorb some knowledge over the next several days. ◆

supporter of ISASI activities, as BEA corporate member and as participant, speaker, and keynote speaker at many of our annual seminars, as recently as 2009 in Orlando, Fla. We are very proud to have such a worldwide-recognized safety investigation expert among our corporate members. He is a most deserving recipient of the ISASI Jerry Lederer Award."

In presenting the Award, Del Gandio said, "Paul has more than filled the criteria to receive the ISASI Jerome F. Lederer Award." Then, turning and speaking directly to Paul, he said, "I have known you for a long time, and these words of introduction don't really do you justice. I am very happy to present you our highest award and proud I can do it. On behalf of everyone here, I congratulate you. "

Following thunderous audience applause, Arslanian put the crowd at ease with a little humor. He then turned serious and said, "Thank you very much. Thank you everybody. Indeed, I am glad. I am honored. I am proud. I am proud of this reward even if I have a feeling that I don't deserve it, totally. What did I do? Not much, if to do something means that you do it alone. Thinking back and reviewing my period in aviation, I realize that I, in fact, always worked within a team; always worked in close cooperation with other people. I have a real feeling that all those people I worked with deserve this reward as much as I do."

He spoke from the heart for some 15 minutes (see page 12) and concluded by speaking to the investigator's social role. He noted that investigative work that involves other professions "generally creates problems to the investigation. They generate confusion, controversy peeps around, and even a crisis may arise. It's part of the job to handle such difficult situations and keep the confidence of all safety stakeholders. Be confident; however, the quality of your work and your professional behavior are your best assets. Do you best, and good luck!"

Closing the evening was the traditional "passing of the gong," the chime used to summon seminar attendees back into session after breaks. Richard Stone, 2011 chair, handed off the gong to Candy Del Gandio and urged all to attend ISASI 2012 in Baltimore, Md., USA, August 27-30. ◆

Regional Cooperation in Accident Investigation, *continued from page 6*

ment establishing the RAIO must be registered with ICAO, as per Article 83 of the Chicago Convention.

Duties and responsibilities of a RAIO

The RAIO should have a clearly defined mission statement in the agreement document. The mission statement will depend on what member states agree should be the extent of the duties and responsibilities of the RAIO: only providing oversight of states' investigations or actually conducting the whole or part of investigations on behalf of member states. Further, it should include the provision of advice and assistance to member states. The mission statement should also provide for the implementation of common regulations, standards, procedures, and documentation relating to standardization of processes and procedures for accident and incident investigation.

Possible organizational structures of a RAIO, as well as staff composition and experience required, are addressed in detail in Doc. 9946.

Two key aspects of the board of a RAIO are of utmost importance: (1) the board should be responsible for formulating policy, appointing the chairman of the board, determining the budget, specifying the terms of reference, and performing other activities related to the overall management and policy-making process of the RAIO; and (2) in order to be effective, it is essential that all member states be represented on the board of the RAIO.

Conclusion

Numerous initiatives designed to help states meet their responsibilities have been undertaken in the past. However, in many regions a number of states have not yet developed the capability for effective accident and incident investigations. A regional investigation system can provide economies of scale by allowing for the sharing of required resources.

The ICAO manual on an Regional Accident and Incident Investigation Organization (RAIO) (Doc. 9946), published in March 2011, provides guidance on the establishment and management of a regional investigation system and outlines the relevant duties and responsibilities of member states. Doc. 9946 assists states, as signatories to the Chicago Convention, to fulfill their obligations pertaining to accident and incident investigation.

Some of the principal objectives of a RAIO would be to

- enhance cooperation and collaboration among its member states, with respect to the investigation of aircraft accidents and incidents.
- ensure the establishment of an adequately funded, professionally trained, independent, and im partial regional aircraft accident and incident investigation organization.
- enhance cooperation within the region and internationally, with respect to the sharing of information on accidents and incidents.
- ensure that all aircraft accidents and incidents occurring in member states are investigated in strict compliance with the provisions of ICAO Annex 13–Aircraft Accident and Incident Investigation.

Working together, member states of a region can better fulfill their investigation obligations and help secure a safer international air transportation system. ◆

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WHO'S WHO

The Boeing Company

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

The Boeing Company is the world's largest aerospace company and leading manufacturer of commercial jetliners and defense, space, and security systems. A top U.S. exporter, the company supports airlines and U.S. and allied government customers in more than 90 countries.

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For more about Boeing and aviation safety, visit http://www.boeing.com/commercial/safety/index.html. ◆