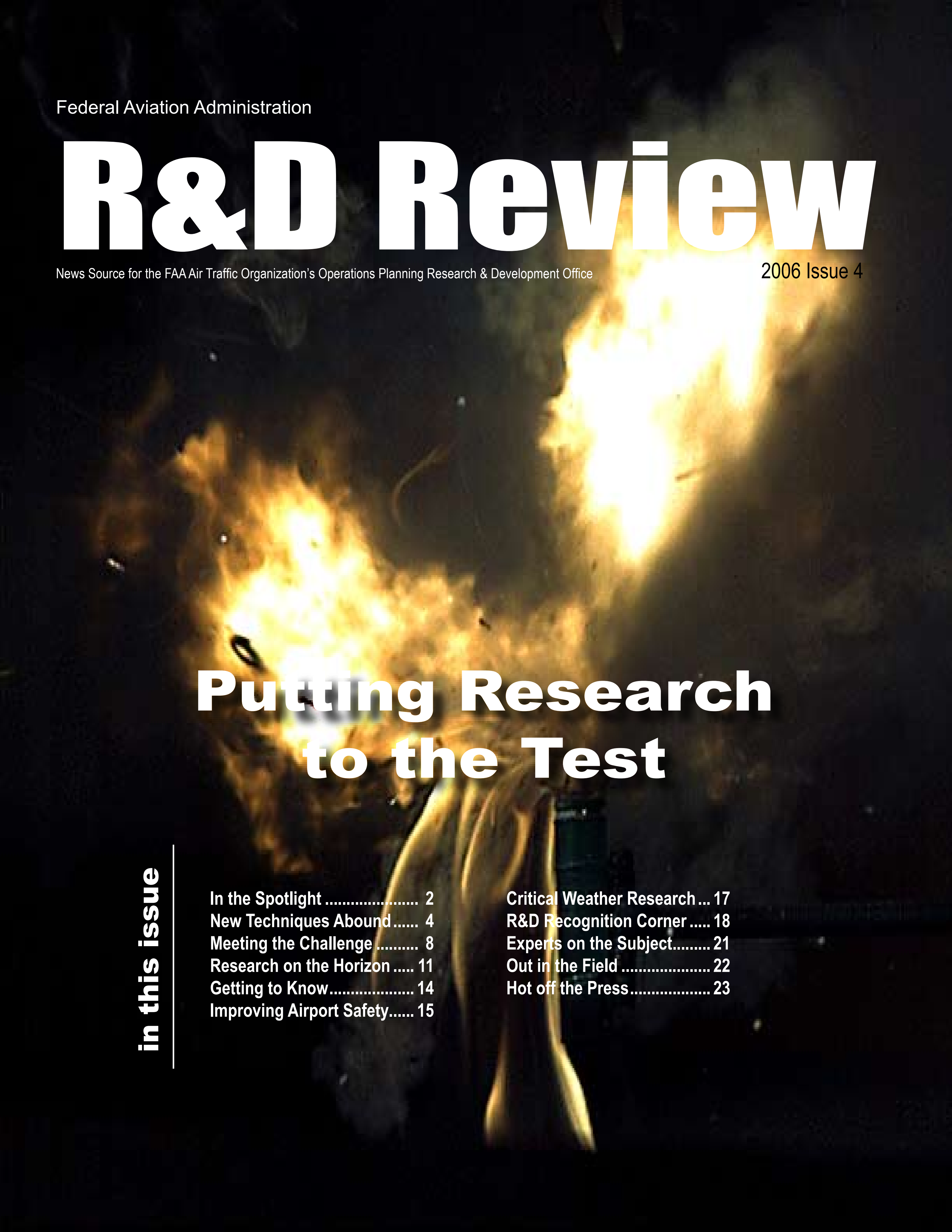

Federal Aviation Administration

R&D Review

News Source for the FAA Air Traffic Organization's Operations Planning Research & Development Office

2006 Issue 4

Putting Research to the Test

in this issue

In the Spotlight

A Talk With Human Factors Program Director, Terry Allard

Dr. Terry Allard joined the Office of Aviation Research last June as the FAA Program Director for Human Factors. Dr. Allard leads more than two dozen psychologists and engineers improving how people perform in aviation environments. Previously, he served as Associate Director of Human System Research and Technology in NASA's Space Exploration Systems Directorate, and as the Chief of the Human Factors Research and Technology Division at NASA Ames. He has a Ph.D. in Psychology and Brain Science from the Massachusetts Institute of Technology.

Q: Would you tell us about your background as a researcher?

A: I have kind of an eclectic background, and have been lucky to be associated with some great people. I was fortunate to be part of the birth of neuroscience as a multidisciplinary field. As a graduate student at MIT, I was trained in psychology, psychophysics and speech sciences as well as in neuroanatomy, neurophysiology, neuropsychology, and neurochemistry. I was introduced to a systems approach to neuroscience that addressed multiple levels of nervous system processing and behavior.

Q: How have you applied your research background to your professional career?

A: I used my scientific training in brain and behavior in my first research management position at the Office of Naval Research, where I built a program that applied cutting edge human brain imaging to fundamental questions of human information processing. As I learned more and more about my naval colleagues who were putting their lives on the line for our nation's defense, I recognized the importance of applying our scientific knowledge to engineering and operations. Among other things, I found out I was good at linking research approaches and knowledge to applied problems by creating communities that crossed technical and operational boundaries. I ended up supporting work in the emerging systems engineering sub-discipline called Human Systems Integration.

At NASA Ames Research Center, I had the privilege of managing a large group of talented psychologists and engineers working a wide spectrum of activities from flight deck human factors, air-ground integration, and air traffic control decision making to more basic approaches to human perception and decision-making. We also worked on space exploration (conducted both by humans and by robots), developing decision making tools for scientists in the Mars Rover mission, and helping to design 'glass cockpit' displays for the Space Shuttle fleet. At NASA headquarters, I led cross-agency science and technology programs enabling human and robotic exploration. We dealt with issues ranging from supercomputers to human factors to propulsion systems, materials, structures, and power distribution and management systems. My last job at NASA was closer to my human factors roots, where I created a human systems integration program for the next generation space vehicle, now called Orion.

Q: Would you please explain similarities and differences between human factors programs at the FAA and NASA?

A: Both organizations have a long and productive commitment to mission-oriented applied research. While at NASA Ames, I was happy to continue a long tradition of productive research with the aviation industry and partnership with the FAA. Historically, the FAA and NASA have complementary roles, with NASA pursuing short-term and long-term projects while the FAA has focused on applying that knowledge and expertise to solving current aviation system problems. As we address the next generation air transportation system, NASA has chosen to define the end state whereas the FAA has to find a way to get there. ►

Q: Why did you seek a position with the FAA research program?

A: It's an exciting time to be at the FAA. Both the Agency and civil aviation are going through an important transition period. System capacity is at maximum, and 73 percent of the air traffic control workforce will reach mandatory retirement age by the year 2014. We're anticipating anywhere from a 60- to 100-percent increase in flight operations over the next 10 years including very light jets interacting with the giant Airbus A380s. It's the brink of a new age, and I think human factors research and engineering will have to play a central role.

Q: What do your responsibilities entail?

A: I wear two hats at the FAA. One, as research program manager, requires planning and anticipating the needs of the FAA and the civil aviation community. It keeps me working in close partnership with requirements sponsors in the Air Traffic Organization (ATO) as well as the Office of Safety (AVS) on the regulatory side. I also must keep in touch with the larger community, including NASA, DoD, Commerce, and Homeland Security, to visualize the future of aviation identifying the critical problems we must address and how to solve them.

The other hat that I wear is that of technical expert and advisor. My group serves in an advisory role for the FAA and the FAA Administrator on issues related to human factors. For example, I'm a member of the NAS Enterprise Architecture Board, convened recently to develop a national airspace framework that will take us into the future.

Q: What are your immediate priorities? Your long-term vision for the organization?

A: The whole move toward additional automation within air traffic management will not eliminate the need for people as critical system elements. Their roles and responsibilities will change but new systems must exploit human capabilities. We want people in the system – they're a creative and resilient resource. There's no artificially 'intelligent system' that is anywhere near as intelligent as a human being. We'll continue to pursue technical approaches including human-in-the-loop simulation, while the future will bring more of an emphasis on computer simulation. Later, we might look at new methods of human reliability analysis as well as better ways to determine safety and risk factors associated with human interaction in complex systems. Because human variability is a fact, we need to design systems that allow recovery from human error. With these concepts, I think we're on solid footing to build a foundation for the future.

Q: From your perspective, what R&D challenges face the FAA and the Human Factors program?

A: Major technical challenges are measuring and predicting human-system performance in current and proposed systems, human automation interaction in network-enabled operations, and changing roles and responsibilities as the aviation system evolves. We must continue to work on seeing the benefits of our research and engineering efforts transition to the field making our current and future aviation systems more efficient and effective.

I'm a person who sees the world as a glass that's half-full, with a pitcher right next to it waiting for me to pour more. There are a lot of opportunities at the FAA. We have critical challenges to address, whether we do the job reactively or proactively. I choose to be proactive. I hope to be able to use the knowledge gained in my previous research management career to help solve important and pressing applied aviation system problems. R&D Review

New Techniques Abound

Exploring Ideas in Icing Research

"Potentially hazardous icing conditions occur not only in flight but also on the ground prior to flight," says Dr. James T. Riley, the FAA's aircraft icing R&D project manager. "On critical aircraft surfaces, ice accumulations on the order of a few thousandths of an inch have been shown to significantly reduce aircraft lift. It is essential that an aircraft be aerodynamically clean prior to takeoff. In flight, under icing conditions, the aircraft must have ice protection systems that allow safe flight without degrading aerodynamic performance or aircraft controllability, and without causing any form of mechanical damage when ice is shed or taken into the engines."

Ice on an aircraft's wing poses a significant safety threat to flight. Usually, after deicing operations, the presence of residual ice on an aircraft's wing is determined visually by a member of a deicing ground crew. Tactile inspections – when a member of the deicing crew actually places a hand on the aircraft's wing cold surfaces – may be required following deicing of certain types of aircraft. As the aircraft engines are often running at these times, the inspector cannot always physically reach all potentially ice covered areas of the wing.

In the mid 1990s, FAA sponsored research to develop a Remote On-Ground Ice Detection System (ROGIDS) technology demonstrator. This system uses a special infrared camera to detect the unique patterns refraction of refracted infrared light caused by frozen contaminants on critical aircraft surfaces. The technology proved particularly effective in sensing dangerous clear ice – caused by difficult weather conditions such as snow and freezing drizzle – that is often almost impossible for the human eye to see. Since the completion of the initial research, two companies have produced prototype commercial ROGIDS.

"FAA and Transport Canada (TC) researchers recently teamed to design and perform two key series of tests needed for the selection and regulation of an approved commercial ROGIDS," reports FAA ground ice detection research lead, Edward Pugacz. "The first study provided objective benchmarks of how well humans actually do at detecting ice on an aircraft wing using conventional visual and tactile methods. In the second study, detection results from two prototypes of commercial ROGIDS were rated against the human benchmarks."

For both studies, researchers embedded ice samples beneath a residual layer of deicing fluid – a layer that is typical of what would remain on an aircraft wing after the deicing process is completed. The first study showed that deicing personnel can easily detect very thin ice tactilely when the sample is contained in a small area, but they have a much more difficult time visually detecting clear ice on bare and painted aircraft aluminum surfaces. The second study showed that despite the impressive sensitivity of human fingers to detect ice, the abilities of one ROGIDS prototype were significantly superior to those of experienced deicing personnel - who performed both visual and the tactile inspections - in detecting ice patches of varying areas and thicknesses scattered on an aircraft wing. The other ROGIDS prototype, which had not had a significant amount of shakedown testing prior to this test, proved to be roughly equivalent to the deicing personnel.

Mr.. Pugacz comments that, "As a result of these tests, the FAA and Transport Canada Flight Standards organizations feels ROGIDS potential to increase the level of safety in icing conditions, with its further development and deployment. Currently, I chair a working group that is developing an SAE Aerospace Standard that the FAA and Transport Canada will use as a basis for approval of the use of ROGIDS for post deicing inspections."

The FAA published the results of these two tests in two reports: Human Visual and Tactile Ice Detection Capabilities under Aircraft Post Deicing Conditions (DOT/FAA/TC-06/21) and Comparison of Human Ice Detection Capabilities and Ground Ice Detection System Performance under Post Deicing Conditions (DOT/FAA/TC-06/20). Both reports are available online at: http://www.tc.faa.gov/acb300/330_documents.asp.

FAA researchers continue to gather knowledge about how exposure prior to takeoff to freezing precipitation of various sorts can degrade an aircraft's aerodynamic performance. Freezing point depressant (FPD) fluids provide protection for a limited period of time to aircraft surfaces when ground operations are complicated by icing conditions. These fluids, the main agents for the actual removal of on-ground ice accumulations, are affected by changing atmospheric conditions. Their time of acceptable ►

effectiveness varies with precipitation conditions. The airlines and operators watch this span of time, known as the holdover time (HOT), which defines the time span when it is safe to takeoff.

New fluids are introduced each season, and testing and evaluations are required to ensure the safe and effective use of these new fluids. Through several ongoing research activities, FAA and researchers provide new and revised HOT guidelines and other technical information for dissemination by the FAA and TC to airlines throughout North America. Formerly, all holdover time testing was done outdoors each winter icing season. Now, research has produced the needed methods and procedures for laboratory testing for freezing drizzle and light freezing rain, allowing fluid manufacturers to determine the holdover times for their new products under strict laboratory conditions. FAA-sponsored research at the National Center for Atmospheric Research (NCAR) has also produced a snow machine that is starting to be used to determine holdover times for snow in laboratory conditions.

The FAA provides holdover times based on testing by fluid manufacturers for operations in meteorological conditions such as light and moderate snow, freezing drizzle, and light freezing rain," explains FAA researcher Warren Underwood. "An aircraft can takeoff within the authorized holdover time without doing a final pre takeoff contamination check. Still, the flight crew needs to monitor the weather conditions to be sure there have been no adverse changes."

"We provide guidelines," continues Underwood, "for operating safely in very light to moderate snow conditions. For light snow, we only require use of the orange, more common, and thinner deicing fluid known as Type I. But we also specify relatively short holdover times. Because Type I lacks additives used in the Types II, III, or IV fluids, it offers limited performance as a true anti-icing fluid. The additives in the anti-icing fluids hold the glycol up on the wing longer and allow us to specify longer holdover times."

During the winter of 2005-2006, in response to concerns within the industry and FAA, FAA researchers undertook research relating to operations in ice pellet conditions. In cooperation with TC, FAA researchers conducted flight testing in Canada in March 2006 using a turbine-powered aircraft. To simulate the operative wintry conditions, the researchers crushed ice in blenders and ran the mixture through sieves to get a size distribution similar to natural ice pellets. Then they spread known quantities of the mix over the wing. In some cases, Type IV anti-icing fluid was also applied to the wing. This viscous (thickened) fluid was chosen for the experiment because it is commonly used by airlines in North America. ►

"Our aircraft icing R&D program has a diverse group of engineers, scientists, and meteorologists who are well versed in all aspects of aircraft ice protection system technology, icing meteorological climatology, aircraft icing regulations and certification criteria, and aircraft operational procedures, ... Our work is succeeding in enhancing safe aircraft operations in both ground and airborne icing conditions."

Next, the aircraft was accelerated to rotation speed and abruptly stopped. These tests indicated that, when the aircraft was protected with Type IV anti-icing fluid, the simulated pellets would readily flow off prior to rotation. The FAA has reviewed the findings and approved 25 minutes as a safe margin, after anti-icing in light ice pellet conditions, prior to taking off from most airports.

The FAA and its partners, especially NASA Glenn Research Center and Environment Canada, are also studying icing during flight to determine better means of protecting airborne aircraft. Most instances of icing involve cloud droplets with diameters between 10 and 50 microns (about the size of the diameter of a human hair). However, larger droplets can pose a special hazard to aircraft. Because ice protection systems only remove or prevent the formation of ice on the leading edge, supercooled large droplets (SLD) with mass tens of thousands of times greater than typical cloud size drops can result in ice forming well aft of the protected region. These accumulations can quickly lead to handling problems and/or performance degradation. "FAA research has resulted in a better understanding of the SLD airframe icing hazard," explains James Riley, "but more work is necessary." As part of our comprehensive safety R&D program, we are working to understand how weather phenomena endanger aircraft and to mitigate those effects."

Adverse weather research and regulations go hand in hand. Before systems can be designed to protect all or some aircraft, there must be a clear definition of the atmospheric conditions in which the aircraft will operate. These conditions can include supercooled clouds, freezing precipitation, mixed conditions, ice crystals, and supercooled ground fog. Associated with these conditions are temperature, altitude, duration, liquid water content, and droplet size.

Federal aviation regulations, such as Title 14 Code of Federal Regulations (CFR) 25.1419, "Ice Protection," require realistic flight tests as the basis for certifying the safe operation of aircraft confronted by icing conditions. Different aircraft manufacturers have employed different types of instrumentation to measure the relevant icing cloud variables, primarily water content, droplet sizes, and temperature. These technologies range from the simple to the complex, from the old to the new, and from the relatively inexpensive to the very costly. Most of the instrumentation comes from the cloud physics research community and requires a certain amount of knowledge and experience to ensure that the probes are properly installed, calibrated, and operated. Furthermore, probe types can have subtle systematic errors that may be difficult for the inexperienced operator or data analyst to recognize.

Because of these complexities, the FAA has relied on the aircraft manufacturers to supply adequate instrumentation and technicians or to hire experienced contractors to install and operate suitable instrumentation and analyze the icing cloud data. The FAA thoroughly researches all underlying factors before altering policies and procedures that would affect the safe operation of ►

aircraft. Recently, in conjunction with a series of test flights, researchers undertook a new study of the properties of instruments needed for the accurate, reliable measurement of icing conditions.

This research resulted in a new set of FAA Technical Notes titled Cloud Sampling Instruments for Icing Flight Tests:

- DOT/FAA/AR-TN06/29, "Cloud Sampling Instruments for Icing Flight Tests: (1) Icing Rate Indicators,"
- DOT/FAA/AR-TN06/30,"Cloud Sampling Instruments for Icing Flight Tests: (2) Cloud Water Concentration Indicators,"
- DOT/FAA/AR-TN06/31,"Cloud Sampling Instruments for Icing Flight Tests: (3) Cloud Droplet Sizers," and
- DOT/FAA/AR-TN06/32, "Cloud Sampling Instruments for Icing Flight Tests: (4) Large Drop Sizers."

These technical notes provide information on the suitability of the procedures and precautions affecting the instruments most commonly used to measure icing rate, cloud water concentration, and droplet sizes in natural clouds or airborne tanker-sprays. They also include advice on data quality assurance, data processing, and the presentation of results. The tech notes are intended as a ready reference for certification officials, designated engineering representatives, aircraft manufacturers, and any other interested parties. They can be found at http://actlibrary.tc.faa.gov.

FAA researchers are also working to assess aircraft propeller icing and its effects on propeller performance. FAA researcher Christopher Dumont is the team lead for an upcoming three-week test at the McKinley Climatic Laboratory at Eglin Air Force Base. The test will simulate in-flight conditions for two engines and five propellers. A primary objective of the testing is to document leading edge and runback ice accretion characteristics in controlled icing conditions on new propeller blades (metal and composite) and in-service metal blades. Measurements will be made to conduct analyses to determine propeller efficiency losses due to ice accretions.

Mr. Dumont was also the lead on a joint FAA-Goodrich-Cessna test in the Goodrich Icing Wind Tunnel (IWT) that investigated the inter-cycle and residual ice that forms on pneumatic deicing boots at slower speeds. Mr. Dumont notes that: "A deicing boot can be installed on a vulnerable surface to remove ice mechanically from an aircraft in flight. Made of a thick rubber membrane, the boot is installed over the leading edges of a wing and control surface (e.g. horizontal and vertical stabilizer), since these are the areas likely to accumulate ice. When atmospheric conditions cause ice to build up, a pneumatic system inflates the boot with compressed air. As the boot inflates, it cracks any ice that has accumulated. The boot is then deflated to return the affected surface to its optimal shape."

An important finding of the test was that for some of the conditions tested, when following typical operating procedures, the boots had to be cycled several times before the main ice shape on the boot was shed.

In addition to inflight icing projects, the FAA and NASA Glenn Research Center are collaborating on research studies involving other aspects of how aircraft can be better protected from the hazards of icing and how flight crews and other personnel can be better trained to deal with icing conditions. This work is guided by regulatory needs, accident report recommendations, and benefit assessments.

"Our aircraft icing R&D program has a diverse group of engineers, scientists, and meteorologists who are well versed in all aspects of aircraft ice protection system technology, icing meteorological climatology, aircraft icing regulations and certification criteria, and aircraft operational procedures," states James Riley. "Our work is succeeding in enhancing safe aircraft operations both in ground and in airborne icing conditions." *R&D Review*

Read more about the FAA aircraft icing R&D program by visiting http://aar400.tc.faa.gov/FlightSafety/RPD557Tasks.htm.

Meeting the Challenge

Unmanned Aircraft Systems

"Because of the extraordinarily broad range of unmanned aircraft types and performance, the challenges of integrating them safely into the NAS continue to evolve. The certification and operational issues described herein highlight the fact that there is a missing link in terms of technology today that prevents these aircraft from getting unrestricted access to the NAS." – Nicholas Sabatini, FAA Associate Administrator for Aviation Safety, September 2006.

Unmanned aircraft systems (UAS) are fundamentally remote-controlled systems - vehicles operated by pilots who are physically separated from them. They can be land-, air-, or ship-launched and can be auto-piloted or remotely controlled by pilots on the ground. Generally, a UAS consists of an unmanned aircraft and associated elements required to operate it safely. They range from hand launched models weighing several-ounces to the size of a commercial jet aircraft. They encompass a broad span of altitude and endurance capabilities. Such aircraft have long been used primarily in military applications of intelligence, surveillance, and reconnaissance. The recent rapid growth of the UAS industry has broadened their applications to homeland securities, such as border security and war on terror, scientific studies of earth, weather, oceanic, and arctic sciences, and other commercial purposes.

Rapid advancements in technology have made UAVs an important tool for the U.S. Because of their ability to operate far beyond manned aircraft in terms of costs and endurances, a UAS offers certain important military and commercial advantages over traditional piloted aircraft.

FAA researchers are planning work to ensure the full and safe integration of increasing numbers of unmanned aircraft systems into the NAS. "Key to successful integration," explains safety researcher Xiaogong Lee, "is to establish standards for UAS operations based on sound engineering principles and technology advances. Rigorous regulatory standards governing the existing NAS users will have to be extended to include these systems. This requires the development of methodologies and tools to define UAS designs, performance characteristics and operations in the NAS. We will be evaluating technologies, conducting laboratory and field tests, performing analyses and simulations, and generating data to support regulatory and safety oversight activities."

"To safely integrate UAS into the airspace system," says Dr. Lee, "the FAA needs to develop airworthiness standards, devise operational requirements, establish maintenance procedures, and conduct safety oversight activities." To accomplish these ambitious tasks within a limited time frame, the FAA UAS research program is divided into seven areas: technology survey; system safety management; detect, sense and avoid (DSA); control, command, and communication (C3); flight termination; certification and airworthiness standards; and maintenance and repairs. "Our research will begin with a baseline survey to determine the existing technologies applied in UAS," says Dr. Lee. "We will examine methodologies applied to meet the regulatory requirement of 'see and avoid,' study UAS control and communication issues to ensure their safe and secure operations, and begin to define necessary safety procedures for the flight termination in dealing with abnormal and emergency situations. Also, we will study detailed issues regarding the continued airworthiness assurance of a broad range of UAS." ▶

The broad goals of safe integration of UAS into the NAS are clear: "do no harm to the system" and "have no adverse impact to existing NAS users." The FAA established the UAS Technical Community Representative Group (TCRG) to identify research requirements that will help to accomplish these goals. Subsequent research activities will be conducted with the FAA UAS Program Office. Specific FAA UAS research program goals to support full UAS integration include:

- By Fiscal Year (FY) 2009, determine DSA performance characteristics and operational requirements.
- By FY 2010, analyze data on the safety implications of system performance impediments to command, control, and communications in different classes of airspaces and operational environment.
- By FY 2012, conduct field evaluations of UAS technologies in an operational environment.

Full and safe integration of UAS into civil aviation requires the FAA to work closely with other government agencies, industry, and international entities that have experience in developing and operating UAS. FAA UAS researchers are actively participating in the RTCA Special Committee 203, which is tasked by the FAA to develop minimum aviation system performance standards for UAS, DSA and C3.

In August 2006, the FAA signed a Memorandum of Agreement with the United States Air Force Research Laboratory Control Science Division to conduct flight tests of DSA technologies developed by the Air Force for Global Hawk and Predator UAS. The objective of this flight test program is to demonstrate the feasibility of DSA technologies that will provide UAS with the ability to sense conflicting aircraft, determine if there is a collision hazard, and autonomously maneuver to avoid mid-air and near mid-air collisions. Under this agreement, the Air Force Research Laboratory will provide a surrogate aircraft to simulate UAS flights and the FAA will provide airplanes to fly as cooperative and non-cooperative intruding aircraft. To best use the flight test program, the FAA will also provide the Air Force with Autonomous Dependent Surveillance – Broadcast (ADS-B) equipment to collect actual operational data to study its potential as a means of DSA.

In addition, the inter-agency Joint Planning and Development Office has identified UAS integration as one of the emerging challenges to the nation's air transportation system. FAA researchers are working closelyon integration with the JPDO and its federal government/industry integrated product teams. R&D Review

Mark your Calendar for

Upcoming Events

2007 Aging Aircraft Conference

The 10th Joint DoD/NASA/FAA Conference on Aging Aircraft will be held in Palm Springs, California, April 16-19, 2007. These meetings bring members of the military and commercial aviation communities together to share information relevant to the continued airworthiness and sustainability of aging aircraft. Presentations will analyze emerging issues and discuss technical and managerial solutions to age-related problems. The conference draws top researchers from throughout the world and attracts over 1200 attendees and 150 exhibitors. The conference addresses the full spectrum of aging aircraft topics of interest to aviation professionals, including:

- Engines
- Avionics
- Corrosion
- Fleet Management
- DMSMS/Obsolescence
- Dynamic Components
- Flight Controls & Aging Non-Structural Systems
- Aircraft Loads (Fixed Wing)
- Aging Non-Metallic Materials
- Aging Space Vehicles & Systems
- Structures - Metallic & Composite
- Electrical Wiring Interconnect System

For additional information about attending the conference, submitting abstracts, or becoming a conference sponsor, see the conference website at: http://www.agingaircraft.utcdayton.com/index.htm.

Second ICAO Global Symposium on Threat and Error Management and Normal Operations Safety Survey

The FAA will host this conference February 7-8, 2007, in Washington, DC. For additional information, or to register, please contact Captain Dan Maurino at dmaurino@icao.int.

7th USA/Europe ATM 2007 R&D Seminar

This conference is scheduled for June 2007, in Barcelona, Spain. Call for papers currently open through January 26, 2007. For additional information see http://atmseminar.eurocontrol.fr/.

2007 Worldwide Airport Technology Transfer Conference New Directions in Airport Technology

This international conference sponsored by the FAA and the American Association of Airport Executives will be held April 16-18, 2007 in Atlantic City, New Jersey. The conference will focus on the development of technology and its application to airports. It will include plenary sessions with internationally recognized keynote speakers, and will break out into more specific technical presentations and exhibitions. Tours of the FAA William J. Hughes Technical Center will include a site visit to the National Airport Pavement Test Facility, built jointly by the FAA and the Boeing Company, now in its eighth year of operation. For updates and additional information on the conference, please visit the FAA ATT07 web site: http://www.airporttech.tc.faa.gov/naptf/att07/ or e-mail: att07@faa.gov

Triennial International Aircraft Fire and Cabin Safety Research Conference

The FAA will host this conference on October 29 - November 1, 2007, in Atlantic City, New Jersey. This conference is the fifth in a series of triennial conferences established to inform the international aviation community about recent, ongoing, and planned research activities in transport category aircraft fire and cabin safety. The conference is designed to address both engineering and cabin crew concerns and requirements. Conference registration details, hotel reservation information, and the preliminary conference agenda will be available at http://www.fire.tc.faa.gov as it becomes available.

Comments

Submit your brief comments to,
publication@cssiinc.com

Research on the Horizon

Attending FAA's Fire Safety Working Group Meeting

The FAA Fire Safety R&D program hosted the International Aircraft Systems Fire Protection Working Group meeting in Atlantic City, New Jersey, on October 25-26, 2006. Approximately, 60 members of the international aviation community attended the meeting. Attendees included representatives from the ATO-P R&D's fire safety research program, Transport Canada, the Brazilian National Civil Aviation Agency, Kidde Aerospace, Boeing Commercial Airplane Group, Airbus Industries, Embraer, Bombardier, the U.S. Navy's Naval Air Systems Command, the Halon Alternatives Research Corporation, Air Liquide MEDAL, and other international institutions in industry and academia.

Seven ATO-P R&D fire safety engineers gave presentations on their current research projects. These briefings included FAA R&D activities to: design and install a nitrogen enriched air distribution system for fire protection testing in the overhead area (known as an inaccessible area) of ATO-P's Boeing 747SP and 737 test aircraft; develop an Onboard Inert Gas Generating System (OBIGGS) cargo bay fire protection test program; finalize a draft Advisory Circular for Handheld Extinguishers for use in aircraft to replace Halon 1211 (banned from production in 1994); work on a new test program to test wing fuel tank flammability using a section of a 727 wing containing a surge tank; and a wrap up of the engine nacelle halon replacement test program. ►

Research on the Horizon *continued from page 11*

Tom Cortina of the Halon Options Research Corporation provided an international environmental update highlighting concerns regarding green house gas emissions, the difficulty of obtaining Halon 1211, updates on the Kyoto Protocol, Montreal Protocol, and the Environmental Protection Agency's Significant New Alternatives Policy (SNAP). Adityanand Girdhari, an ATO-P R&D fellowship student from Rutgers University, provided a summary of his work on the development of a cargo compartment multi-sensor detector. Several working group members also highlighted their recent research projects.

ATO-P R&D's Richard Hill chairs the working group, originally established in 1993 as the International Halon Replacement Working Group. Since its inception, the group has increased its focus to include all fire protection research and development for aircraft, including hidden fire fighting, hazardous materials transport, fuel tank flammability, fuel tank inerting, cargo compartments, engine nacelles, handheld extinguishers, and lavatory trash receptacles. The group meets two times per year. *R&D Review*

The Bureau of Transportation Statistics, a part of DOT's Research and Innovative Technology Administration, reported U.S. airlines carried 439 million scheduled domestic and international passengers on their systems during the first seven months of 2006, 0.5 percent more than they did during the same period in 2005.

Courtesy of: BTS ▪ Research and Innovative Technology Administration ▪ U.S. Department of Transportation
400 7th Street, SW ▪ Room 3103 ▪ Washington, DC 20590 ▪ 800-8531351 answers@bts.gov

Getting to Know . . .

Human Factors Researcher, Eddie Sierra

What is your professional background?

I received my M.S. in psychology from Georgia Institute of Technology in 2002 and started working as a human factors engineer with L-3, Titan after graduation. I supported the FAA and NASA on various projects, such as the GPS Outage En Route Simulation, Pilot Perceptions of Airspace Complexity, Aircraft Landing Lights Enhance Runway Traffic Safety, Advanced Controller Training in a Virtual Environment, Human Visual and Tactile Ice Detection Capabilities under Post Deicing Conditions, Comparison of Human Ice Detection Capabilities, and GIDS Performance under Post Deicing Conditions. Right before I came to the FAA, I served as project manager for the L-3 Titan team supporting the Simulation and Analysis Group at the Tech Center.

What made you choose aviation as a career?

The McNair Scholars program at Our Lady of the Lake University in San Antonio, Texas, where I received my B.S., gave me the opportunity to pair up with a scientist over a summer to get some research experience. I worked with Dr. Steve Watson, who was doing a project for the Air Force Research Lab, Brooks Air Force Base, Texas. Our research focused on whether mental rotations performed on a desktop computer during training would transfer to the operation of remotely operated vehicles (ROV). Mental rotations or translations are required when you are navigating and your display, such as a map, is not oriented in the same direction. For example, if you were flying an unmanned aerial vehicle north, a movement of the joystick to the right would make the vehicle go east. However, if the vehicle were flying south, a movement of the joystick to the right would make it go west.

We trained two groups on a desktop computer using a different training method for each (control group versus mental rotation training group) and then compared how well each group drove an ROV through a maze. The control group performed better than the mental rotation training group, which shows that the training would transfer. The experience of being a part of a research project from beginning to end was so awesome that I was hooked on human factors and aviation.

What is your current position?

Scientific and Technical Advisor for Human Factors.

How long have you been with the FAA?

I've been with the FAA a little over 11 months.

Why did you choose a career with the FAA?

Like most people, I want to do something good for my country. I feel like I can have an impact on the safety of people by doing my job well.

Where do you see your career in five years?

In five years, I see myself at the FAA managing human factors programs to address important issues that arise as our system changes and moves toward the Next Generation Air Transportation System.

What projects are you currently working on?

I'm working on a number of projects in training to support our answer to the air traffic controller workforce challenge. I'm also contributing to some human factors engineering projects.

What are some of the challenges you face?

There is a lot of knowledge that we've gained through human factors research, but that knowledge needs to be transformed into something that people can use to solve problems. I feel responsible for getting information from the research reports into the field to help improve the national airspace system. There are a lot of challenges that come with this responsibility.

Would you share one of your recent accomplishments with us?

Does landing this job count?

What advances in aviation do you foresee over the next five to ten years?

The FAA is taking serious action to address the training of our workforce. All of the stakeholders are talking and looking for some efficient and effective training solutions. I believe that we have the best workforce in the world and the evidence of that is in the performance of our national airspace system. However, the process needs to be modernized. I think the FAA is doing that by analyzing the competencies required of our modern workforce, looking for improvements in the design of the training system, and evaluating new approaches to training implementation. I expect that the evaluation of this new training system will also be improved.

What advice would you share with people considering a career in aviation?

There are a lot of opportunities in aviation now and I expect that there will be even more in the future. It doesn't matter what field you're in; there is a place for you if you are interested in working in aviation and doing something for your country.

Is there anything else you would like our readers to know about you?

My wife, Judie, and kids, Arielle, Cameron, and Dominic support and energize me greatly. This job comes with a lot of travel. Judie does everything that she can to make it go smoothly and keep me connected with my family whether I'm in Alaska or on the commuter bus at 7 p.m. They show a lot of interest in what I do, which makes me think, "I'd better do something good today."

Improving Airport Safety

Engineered Materials Arresting System

On October 13, 2006 a Gulfstream G-II, carrying seven passengers, including Yankees third baseman Alex Rodriguez, overran the runway at Bob Hope Airport in Burbank, California, and was brought to a safe halt by a specially engineered cellular concrete runway arresting system. None of the passenger or crew suffered injuries and the plane had only minor damage. This was the fifth aircraft stopped by an Engineered Materials Arresting System, or EMAS, since the FAA approved the first installations at U.S. airports.

On July 17, an EMAS, stopped a business jet whose brakes failed during landing at the Greenville Downtown Airport in South Carolina. The Dassault Falcon 900 came to a controlled stop within 100 feet of the threshold when the plane rolled into the EMAS at the end of the runway. The five people aboard were not hurt, and the jet suffered no damage.

“We are pleased that years of research are paying off,” says Ryan King, a civil engineer who studies runway surface technology for the FAA. “Our engineers began looking into whether soft-ground arresting systems would work after a Scandinavian Airlines DC-10 went off the runway at JFK [New York] in the mid 1980s.”

Working with the FAA, the Port Authority of New York and New Jersey, and the University of Dayton, a company called Engineered Arresting Systems Corporation (ESCO) developed EMAS to safely decelerate aircraft coming off runways at high speeds. “This runway overrun material is cement powder, water, and foam bubbles – the exact recipe is proprietary,” describes King. “You can make an impression in it, break it off, and it just crumbles into dust. Regular concrete weighs 150 pounds per cubic foot. But the cellular concrete weighs about one-tenth of that.”

In 1996, technicians installed the initial EMAS runway safety area at John F. Kennedy International Airport. To date, it has stopped three aircraft at that airport: a commuter aircraft in 1999, a cargo jet in 2003, and a jumbo jet in 2005. “Generally, the largest plane you serve is the one you design the EMAS for,” explains King. “For JFK, it’s a Boeing 747 exiting the runway at 70 knots. The distance is determined by the amount of real estate you have and the design aircraft serviced by the airport.” ▶

EMAS is installed in the Runway Safety Area at the end of a runway. A typical EMAS bed will consist of blocks of material laid out in rows. The first row will usually consist of six-inch blocks, then each subsequent row will get slightly thicker, until the overrun area ends with blocks up to thirty inches thick. The surface is designed to decelerate an aircraft quickly and safely.

The use of cellular concrete runway overruns is expanding, both in this country and across the globe. China has EMAS and Spain plans to build a system. The arresting systems are now keeping overrun accidents from happening at 15 American airports. Three more EMAS installations are being completed this fall. One of those new locations is Teterboro, New Jersey, where 13 people were hurt when a corporate jet overran the runway in February 2005.

Chicago's Midway Airport, scene of a fatal overrun in December 2005, is a special case, King says. "We're learning that anything might be better than nothing. Midway's runway ends in a corner, a traffic intersection, so they're considering a wedge of EMAS material. Clearly, it's not going to be enough to stop the largest aircraft at 70 knots, but four EMAS beds are being installed there."

By the year 2015, Congress will require 284 major U.S. airports to extend runway safety areas, reconfigure present runways to include overrun room, or install arresting systems. For U.S. installations, the cost to install an EMAS generally ranges between $2 million and $4 million, plus site preparation. Airports can apply to the FAA for Airport Improvement Program (AIP) grants to help defray the cost of the system.

In the meantime, Ryan King is leading projects aimed at improving EMAS. He says, "We built a testbed of 160 blocks at the FAA William J. Hughes Technical Center to examine deterioration under differing weather conditions. We've instrumented the bed with strain gauges to measure surface weight as well as more than 100 sensors that detect variables such as temperature, humidity, and moisture. What we're doing is looking at the long-term environmental durability. Eventually, we'll take a block out and do some forensics on it to determine whether it has deteriorated – and, if so, by how much."

Another research project involves testing the cellular concrete under extreme cold. As part of an interagency agreement, ESCO will provide EMAS to the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory. "The lab has an environmental chamber where scientists can subject the material to lower temperatures and accelerate freeze-thaw cycles to find out the effects of a winter's worth of harsh conditions in a matter of weeks," King states. He is currently working on a report about the history of EMAS research. *R&D Review*

For more information on the FAA's EMAS research, visit http://www.airporttech.tc.faa.gov/safety/sgarrest.asp.

Critical Weather Research

Predicting the Weather

"Accurate prediction of thunderstorms is critical to aviation, since convective weather causes approximately 50 percent of all delays in the national airspace system," explains Gloria Kulesa, FAA Aviation Weather Research Program Manager. "Pilots, airline dispatchers, and FAA traffic flow managers need tools to help them plan flight routes around thunderstorms rather than undertaking the tactical maneuvering that now results when unforecasted storms occur. They need both a precise and timely shared picture of current weather as well as an accurate, reliable short term forecast."

When hazardous weather hits a crowded terminal airspace, departure routes are closed and arrivals are given priority. Substantial departure delays result, but even if as few as one or two flights per hour can leave the airport, that improvement can greatly benefit the system and reduce delays significantly. "The New York terminal airspace suffers from significant weather-related delays, particularly during the summer months," says Kulesa. "FAA researchers found that many of the delays that occur with the New York terminal airspace could be avoided if the FAA could provide predictions both of thunderstorm decay and of the onset and ending of capacity limiting events such as low ceilings or high surface winds."

To provide accurate and timely thunderstorm forecasts, FAA-funded researchers went to work to develop a software enhancement to the Integrated Terminal Weather Forecast System (ITWS) already installed at major U.S. airports. The ITWS is an automated weather information system that receives data from weather and surveillance radars and sensors. Its software displays current weather information in graphic and text formats. The system detects and predicts wind shear, microbursts, and gust fronts and displays current precipitation levels. It also tracks the speed and direction of storm cells, predicts the movement of storms, and detects weather hazards such as hail, lightning, and tornadoes.

To provide needed short-term forecasts, the FAA Aviation Weather Research Program funded the multi-year development of the Terminal Convective Weather Forecast (TCWF). In 2006, the FAA began incorporating the TCWF software into the ITWS. The FAA deployed the operational tool in New York this summer. By the end of 2006, the tool was deployed at 17 additional ITWS sites. TCWF provides an animated one-hour forecast of thunderstorms, including growth and decay. It also provides a higher resolution (1 kilometer) long range precipitation map for a more precise depiction of surrounding storms and much better depiction of winter precipitation. The FAA estimates that by 2008, when fully deployed at all airports scheduled to receive it, ITWS will deliver an annual benefit of $524 million.

This patented technology, developed by MIT Lincoln Laboratory with FAA funding, includes a growth and decay storm tracker that generates forecasts of large scale, organized precipitation features with operationally useful accuracy. According to Kulesa, "It represents a breakthrough in short-term forecasting capability, providing quantitative envelope tracking as opposed to the usual cell tracking." *R&D Review*

For additional information, please see http://www.ll.mit.edu/AviationWeather/tcwfp.html.

R&D Recognition Corner

Fire Researcher Wins Award

"Everybody said it couldn't be done," says the FAA fire materials researcher Richard Lyon. "When I told all the experts I was going to make an instrument that measures fire resistance of tiny sample materials, they claimed it was impossible, and advised me not to waste my time. That made me even more determined, because I knew I could do it."

Now, Lyon's microscale combustion calorimeter holds the 2005 Award for Excellence from the Northeast Region of the Federal Laboratory Consortium (FLC) for Technology Transfer. Judges picked his patented invention from submissions by the three dozen member government research and development laboratories in New Jersey, New York, New England, and Puerto Rico. "I'm just one member of a team of brilliant people," explains Lyon, who admits he had a lot of help coordinating the technology to make it work. "There are little pieces that all came together to make the calorimeter a functional piece of equipment. There are about five FAA fire safety researchers and approximately 20 people around the world who helped make the calorimeter a reality."

Lyon says the calorimeter would not exist without the contributions of Richard N. Walters, an FAA research chemist, and Dr. Stanislav I. Stoliarov of SRA International. "Rich provided both knowledge of hardware and ability to write software. Stas contributed the mathematical ability which allowed us to invent a new and better way to control the heating rate during the test, and his method is significantly less expensive than current technology ."

Compared to previous procedures, the calorimeter uses much smaller samples and conditions that simulate burning in a laboratory test without a flame. It obtains results in minutes instead of hours or days using a tiny percentage of the amount required for the various tests to calculate fire hazard indicators of a material. Before this new technology, scientists would need at least a kilogram split among at least three different devices. Both the American Society for Testing and Materials (ASTM) and the International Standards Organization (ISO) are considering new standards written by Lyon for the microscale calorimeter.

Calling traditional test methods inadequate for the FAA's life-saving mission, Dr. Lyon says, "Our research program can't tolerate the inconsistent results you get from sticking a chunk of plastic into a Bunsen burner flame, a test that depends on how (at what angle) you insert the sample and how thick that sample is. These factors have nothing to do with the flammability of the material itself."

"The new calorimeter scales down the flammability test to let us work with, essentially, one molecule of material," continues Lyon. "Most of our samples are the size of a period at the end of a sentence. By shrinking the sample down to that size, we have eliminated all of the things that happen during a test to give false results. Now, whatever happens to that sample is what the molecules themselves do in a fire."

Lyon says the microscale combustion calorimeter is also much more reliable than present testing technology. It offers labs a significant reduction in cost, resource consumption, and pollution over the bench-scale methods used around the world. Lyon believes his invention might eventually come to replace the technologies currently used to test, directly or indirectly, the heat released by combustion. These include: the cone calorimeter, the rate of heat release apparatus, flame spread tests, flame resistance/ignitability tests, and, the oxygen bomb calorimeter. By eliminating extraneous factors and focusing on the fire behavior of the molecule itself, the microscale combustion calorimeter can help create new ultra fire-resistant materials that could have worldwide implications in more than just the aviation industry. "Now that we know how flammable the molecule is, and we know all the different atoms and chemical groups that make up the molecule, we change the composition in a systematic way and pick out what parts of the molecule are flammable and what parts are not flammable," explains Lyon. "By combining the nonflammable parts into a single molecule, we have been able to make ultra fire resistant plastics by molecular engineering." The FAA is collaborating with two Fortune 100 chemical companies who are using the FAA's approach to reduce the flammability of their own plastics.

As a result of this invention, the FAA and its partner universities have earned three composition-of-matter patents for new molecules designed with the microscale combustion calorimeter, and the FAA has two current patents for the instrument - and another one pending. The FAA has licensed two manufacturers to produce and market the machines and the two companies have licenses to use the calorimeter on their sites.

"Our job is to create a fireproof aircraft cabin," say Lyon. "Everything we do is geared toward that one goal." In the end, Lyon says, "the impossible wasn't really so impossible. All we needed was the knowledge, the technology, and a can-do attitude to back it all up."

Read more about Dr. Lyon's work by visiting http://www.fire.tc.faa.gov/research/research.stm.

What You Don't Know About Rich Lyon

As a new student, Rich Lyon must have looked a little out of place when he showed up at the University of Massachusetts gymnasium three decades ago. He got recruited to play in a basketball game against a team fielding fellow Minuteman Julius Erving. "I did play a pickup game with Dr. J in the gym," Lyon admits. "They needed someone, and I said yes."

That was before Erving became an 11-time NBA All-Star and member of the Hall of Fame. While in high school, Erving earned the nickname, "Doctor," for the way he operated on the court. While at UMass, Lyon earned his doctorate in polymer engineering. Erving went professional before graduating; Lyon is revolutionizing his profession after graduating.

New PARTNER Website

The FAA Partnership for AiR Transportation Noise and Emissions Reduction recently debuted a new website, http://mit.edu/aeroastro/partner/. In addition to being updated and more robust behind-the-scenes, just a few of the new features include:

- Project descriptions (not official websites) include
  - –Research activities,
  - –Contact lists showing names, phone numbers, and emails of PARTNER investigators, program managers, and other personnel, and
  - –Download capabilities for existing/available reports.
- Common acronym lists.
- News page with articles and events.
- Resources section (new) with meeting information, logos, templates, etc.

It's important to note that this is a dynamic site is in its early stages. It will continue to grow and evolve. Upcoming changes and additions include:

- The People page will be switched to a database-driven file sortable by the user.
- The news page will include an RSS feed for subscribers. We will also have a regular emailed "ejournal" linked to Web stories.
- Downloadable handouts, including a basic PARTNER briefing paper and a project description handout will be added in a few days.
- Images will gradually be replaced with those from the projects.
- As more reports are added, they will be searchable by topic.
- ... and a lot more.

FAA Names 'Excellence in Aviation Research Award' Winner

The FAA is presenting its 2006 Excellence in Aviation Research Awards to the Department of the Navy's Terrain Awareness Warning System (TAWS) Team.

"This technology is saving lives," said FAA R&D Director Joan Bauerlein. "The Navy's research and development efforts on the terrain awareness warning system are dramatically improving the safety of military aviation and helping to meet safety goals for the national aviation system."

The Naval Air Systems Command Terrain Awareness Warning System alerts the aircrews who are about to encounter Controlled Flight into Terrain (CFIT) conditions. At the core of this safety backup system is the patented TAWS software developed by the Air Combat Electronics program office led by Captain Gregory Silvernagel. In essence, this software determines when to provide aural and visual warnings to aviators who have lost situational awareness.

While available commercial-off-the-shelf solutions for CFIT protection are effective for military transport aircraft, they are not suited to the requirements of tactical aircraft. These planes, for example the F/A-18, must operate at very low altitudes and high speeds to accomplish their assigned missions. Because existing commercial systems are ineffective in that environment, the Navy developed a software solution to warn U.S. Navy and Marine Corps aviators of imminent CFIT hazards.

The Navy developed the TAWS system at a cost of approximately $10.8 million over four years, an exemplary use of funds. A single F/A-18 aircraft costs approximately $80 million, and the lives saved when protecting even one of these aircraft are priceless.

This is the ninth presentation of the prestigious Excellence in Aviation Research Award. The awards are given annually to individuals and/or institutions outside of the FAA whose research contributions have resulted in a significantly safer, more efficient national airspace system.

R&D Recognition Corner

49th Annual Better Way Award

The FAA and Air Transport Association of America (ATA) recently recognized the recipients of the 2006 FAA-ATA Non-Destructive Testing (NDT) Forum "Better Way" award.

The "Better Way" award recognizes a team of government and airline industry individuals who have collaborated to advance inspection or testing of aircraft structure, components or systems. This award, jointly sponsored by the FAA and ATA, was presented at the ATA Non-Destructive Testing (NDT) Forum on October 18 in Ft. Worth, Texas.

Professionals from industry as well as government were recognized with this prestigious award. From Delta Air Lines: David Piotrowski, John Bohler, Richard Watkins, Ramesh Ramakrishnan, Doug Jury, David Steadman, and Mark Boudreau (now with FedEx Express). From Drexel University: Bao Mosinyi. From the FAA Technical Center: John Bakuckas, Amlan Duttchoudhury (now with The Boeing Company), and Doug Koriakian. From Sandia National Labs – AANC: Mike Bode, Floyd Spencer, and David Moore.

The team received recognition for its efforts to summarize 20 diverse NDT techniques used to assess damage on longitudinal lap joints. The results of this effort are documented in a database that will provide end-users at airlines and repair stations with the information needed to make informed decisions about the capabilities of the various NDT techniques.

Ensuring General Aviation Safety

Each year the FAA Eastern Region recognizes individuals who are contributing to safe operations in general aviation. FAA researcher Christopher Dumont received an award at this year's ceremony. Dumont has been a safety counselor for the Philadelphia Flight Standards Office for a number of years. A flight instructor with the FAA Flying Club, Dumont has done a number of presentations on aircraft icing. He also helped create the Crew Resource Management (CRM) video that was produced in conjunction with the Flight Services District Office and Art-Z Graphics about a year ago.

Chris Dumont has made a commitment to ensure safety in general aviation. He spends at least one evening each year renewing his counselor status, along with numerous programs throughout the year at several airports.

Sharing Her Expertise

Holly Cyrus, FAA Project Manager, Aircraft Safety and Airport R&D, delivered the keynote address on October 18 at the IEEE/AIAA Dinner Meeting. Her entertaining and informative presentation was titled FAA Research in Airport Lighting and Signage for Safer Landings and Pilot Operations. Attendees heard about the work the Aircraft Safety and Airport R&D Team is conducting that will result in safer landings, departures, and operational use of runways. Ms. Cyrus discussed leading edge research that will improve airport signage, lighting, and pavement marking. Additionally, she discussed lighting issues related to wind turbines and light emitting diodes (LED). The audience learned:

- How LED technology interacts when interspersed with standard incandescent lights on airport circuits,
- How LED intensity changes can be effected,
- How the "narrow spectral band" of LEDs impacts pilots with certain types of color deficient vision, and
- How LEDs can be seen on an enhanced vision display.

Ms Cyrus has a BS in Mechanical Engineering from the University of New Mexico and an MBA from Capella University of Minnesota. In addition to her 18 year FAA career, she currently chairs the IEEE affiliate group, Women in Engineering.

Experts on the Subject

2006 Risk Analysis Conference

The world's top aviation safety experts exchanged ideas recently at the 2006 Conference on Risk Analysis and Safety Performance in Atlantic City, New Jersey.

Rosanne Weiss, a FAA flight safety researcher, chaired a planning committee that organized and hosted the conference. "It's all about making choices – everyone takes some risk every day – but for most people, it doesn't come with balancing the lives of 200 passengers. When there's an incident, people look at risk analysis as a way to prevent such a thing from happening again, to consider the events in play that could have stopped it," explains Weiss.

The FAA's Seventh Risk Analysis Conference attracted 220 specialists from almost every corner of the globe. "We had industry people, university people, airline people, researchers, and representatives from foreign governments and U.S. government agencies," Weiss says. "The military came, too – Air Force, Navy, Coast Guard – they're all dealing with the same issues as we do in the FAA."

Huan Nguyen, Director of the FAA Safety Risk Management Office, spoke first about Safety Management Systems. "SMS is the way we can look at ever-increasing demand on systems and ensure that safety remains at current level or better," said Nguyen, who encouraged listeners to take many ideas back to their organizations. The second speaker, Wes Timmons, Manager of the FAA Safety Management Oversight Division, urged attendees to get more involved: "Whether you're a regulator or an airline, as a provider, you have a primary responsibility for safety. You must manage safety across the enterprise and within systems."

Don Arendt, from the FAA Flight Standards Safety Analysis Center, summed up his view of the need for SMS: "If we're still wrecking airplanes, obviously there's something wrong." He added the FAA's SMS, which at this stage is voluntary, would provide systematic methods to control risk effectively. David C. Gilliom reinforced that theme. As lead for the FAA's new inspection program, the Air Transportation Oversight System (ATOS), Gilliom supervises design of ATOS and its deployment to all CFR Part 121 carriers. He prefers to think of ATOS not as a surveillance activity, but more as a tool to organize the review process to ensure airlines are dealing with hazards. Gilliom said, "Safety has to be designed into the process, and not resolved with inspections after the fact."

ATOS should end traditional mandatory checks by individual FAA inspectors at the operational level and identify safety trends on the system level before an accident occurs. "We want to reduce the burden on regulators," said Gilliom, "and build on collaboration with the carriers, employing risk analysis to determine any enforcement actions." Richard Abbott, a lead for the FAA's System Approach for Safety Oversight program, told the conference, "Managing the risk is up to each carrier. It's our job to make sure that happens."

In addition to oversight, the subject of information sharing dominated the conference. Tom Chidester, FAA human factors researcher, managed the development of the Voluntary Aviation Safety Information System while at NASA.

He and others think the FAA has addressed concerns about protecting sensitive proprietary data. Chidester said, "We've got to get rid of the stigma that's keeping people from participating." Timothy J. Logan of Southwest Airlines acknowledged the program protects the identities of participating carriers and pilots while it allows the airlines ownership of their data by involving them in analytical processes.

Speakers also came from JetBlue and United Airlines. "Airlines explain how they analyze risk, and it helps everyone analyze risk better," says conference organizer Rosanne Weiss. Other highlights included a briefing on 3NASA's technical troubleshooting team by Ken Cameron, a former space shuttle commander. The manager of the FAA Engine and Propeller Directorate, Jay Pardee, discussed his role as Safety Integrated Product Team leader for the Joint Planning and Development Office.

British Airways, Australia's Civil Aviation Safety Authority, and other organizations around the world are also implementing or planning risk management systems. Canada already has a risk management system in place, which participants heard about firsthand. Mike Plottel, Director of Safety Services for WestJet, the second largest Canadian airline, says, "We embrace change while involving the entire corporate structure, from the top down." Andrew Rose, air safety investigator for British Airways echoed that approach, and added his carrier is being proactive by requiring pilots to report even borderline incidents.

The views of attendees from other participating nations intrigued the attendees. EUROCONTROL's Eric Perrin explained how SMS influences causal model fault trees. "We are creating more opportunities for prevention at the planning level than at the technical level," he said. Other speakers represented the NLR, the Dutch aerospace laboratory, Airbus (the European manufacturer), CASA Australia, and Transport Canada. Hendrik Schorcht, who detailed a research project at Technical University of Berlin, said German process identification led to 1,800 relevant operational processes that figure into SMS. A regulator from New Zealand, Peter Nalder, put it succinctly: "We don't 'make' safety, but influence it."

In his keynote speech, David Mawdsley of the International Air Transport Association lamented the myriad initiatives that appear to overlap. IATA's retiring Safety Director said, "We need to prioritize on a global scale. If we see people as capital, our assets need to be deployed more effectively."

In his parting words, FAA analyst Don Arendt reminded the conference of someone he called the greatest mind in the field …"If you remember back to December 17, 1903, Wilbur Wright made his brother fly the airplane." R&D Review

Out in the Field

FAA's Field Researcher, David Blake

Most of the time, engineer David Blake works unassumingly out of a FAA laboratory studying fire detection and conducting fire safety research projects. When he is called away from the lab, it is of the utmost importance. The National Transportation Safety Board (NTSB) routinely requests that he lend his analytical skills in the field to provide FAA support at the investigation of aircraft fires.

"The Fire Safety Branch has always maintained a good relationship with the NTSB," says Blake, who has participated in nearly 40 aircraft fire investigations over 20 years. "It's a two-way street. Not only do we provide a benefit to the NTSB, but we gain information from going out to the sites."

Blake's supervisor, Constantine (Gus) Sarkos, explains the close association with the NTSB. "Our projects involve the different phases of a fire from its initial cause to how it spreads, how quickly it spreads, and how quickly – or slowly – it's detected and extinguished. We have specialists who look into detection, extinguishment, prevention, materials' flammability – every facet and characteristic a fire exhibits. An improvement in only one facet of fire safety may be capable of preventing an accident or mitigating the effects of a fire."

On February 8, 2006, the NTSB summoned Blake and FAA colleague Rob Morrison to Philadelphia International Airport, where they helped an NTSB team examine the wreckage of a UPS DC-8 that landed in flames early that morning. They continued the investigation for days, a tiresome, time-consuming task complicated by the cargo plane's contents, thousands of packages sent from the Atlanta freight carrier's hub. Blake's obligation did not end at the scene. In July, he testified before an NTSB hearing, which will incorporate Blake's testimony about aircraft fire detection and suppression systems into its final report on the incident.

"By participating, we see real accidents, real fires, and the issues involved, so it helps us develop our test programs to actual circumstances in the field," Blake explains. "You see the fire implications of different materials, and how fire is a factor in different ways in different accidents, whether it's a postcrash external fire or in-flight fire, and the knowledge that's gained in participating helps us design realistic test programs in the laboratory."

Blake is always taking information back to the FAA that may impact future research projects. From the Philadelphia fire scene, he collected data about the response of several smoke detectors in the airplane, the spread of smoke from the cargo compartment to the cockpit, and the effectiveness of emergency smoke removal procedures. Quite often, Blake says the NTSB asks him to conduct follow-up tests or further studies to help determine a cause.

"We have unique capabilities, for nobody else has indoor airplane fire-testing facilities. We have a wide-body airplane, a narrow-body airplane, a commuter airplane, so we can model virtually any fire scenario the NTSB asks for, and have it well-instrumented so we know what the hazards are, what the timelines are for the fire stages," states Blake. "In addition, our in-house technician support enables us to set up a test very quickly, and get results for investigators with a short turnaround time."

Blake also helps formulate FAA responses to NTSB recommendations. For instance, he is currently helping develop a training video for in-flight firefighting, which the NTSB suggested after it documented cases in which flight crews afraid of toxicity instructed flight attendants not to use the portable Halon (bromochlorodifluoromethane) extinguishers. In addition, he performs other duties for the NTSB, which included a lecture this summer on aircraft fires at an NTSB Survival Factors course at their training facility in Virginia. His lectures generally focus on the flammability properties of aircraft materials, the cabin environment during postcrash and in-flight fires, and the effectiveness of handheld fire extinguishers.

Blake also works with fire researchers at NASA, Sandia National Labs, the National Institute of Standards and Technology, and many other federal agencies. He says, "Their scientists may have areas of expertise, different ways of doing things that might benefit us. We have interagency agreements with them so they might do parts of a project for us. It's very important to include the specialized expertise of other government colleagues to improve the final product."

Still, Blake harkens back to his experience visiting aircraft fire scenes with NTSB investigators: "When you participate at an accident scene, it's all relevant. Whatever you learn, you share with colleagues in the lab, make more realistic tests, get rules changed, and improve fire safety.

"What we've learned has resulted in very definite, measurable improvements over the past 20 years in all areas of aircraft fire safety," Blake continues. "Our research is saving lives." R&D Review

Guidelines to Minimize Manufacturing Induced Anomalies in Critical Rotating Parts (DOT/FAA/AR-06/3)

The FAA and Aerospace Industries Association Rotor Manufacturing Project Team (RoMan) undertook this research in response to accidents and incidents caused by manufacturing induced anomalies in critical rotating parts. According to a 1997 summary from the AIA Rotor Integrity Sub-Committee, post-forging manufacturing induced anomalies caused about two percent of rotor cracks/events.

The guidelines presented in the report represent an industry consensus on the currently available best practices to minimize manufacturing induced anomalies in critical rotating parts consistent with the AIA RoMan team charter and vision. Recommendations for nominal rotor manufacturing process development and control, including process validation, quality assurance, disposition of suspect parts, process monitoring, human factors and training, and non-destructive evaluation, are included to provide an overall framework for a highly reliable manufacturing process. Because critical rotating part reliability has demonstrated particular sensitivity to hole machining practices, specific recommendations for hole making are included. In addition, a section containing industry lessons learned is included to provide guidance on issues common in the industry.

Feasibility of Malsr and Runway Lighting For ILS Approaches for Helicopters (DOT/FAA/AR-TN05/55)

FAA researchers and engineers performed a human-in-the-loop Copter Instrument Landing System (ILS) study in a Level D Sikorsky 76 simulator at Flight Safety International, West Palm Beach, Florida. For this study, researchers evaluated the adequacy of airport lighting to support helicopter approaches with reduced minima. Specifically, the study investigated whether a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights, runway markings, and runway edge lights, only, would be adequate for helicopter pilots to perform an instrument approach to 100-ft decision height above the ground with visibility averaging to 1/4 mile during three time-of-day conditions (day, night, and dusk) and successfully land the helicopter using a prescribed approach and landing technique.

The majority of participant feedback and performance data, based on a sample of 14 pilots, supported the feasibility of the Copter ILS procedure in terms of lighting and visual cue adequacy and the two-person crew landing technique. Some pilots did point out that the addition of runway centerline lighting would be helpful. They all agreed a two-person crew would be essential to the safety of the procedure.

Safety and Certification Approaches for Ethernet-Based Aviation Databuses (DOT/FAA/AR-05/52)

With the advent of higher-performance computing and communication systems, aircraft will have the capability to process an unprecedented amount of information pertaining to performance, safety, and efficiency. Flight instruments will be integrated to share information and to cooperate with each other. It is inevitable that a high-speed and versatile network infrastructure will be required in the next generation of aircraft.

One commercial off-the-shelf technology, Ethernet, is seen as potentially attractive in avionics systems due to its high bandwidth, low wire count, and low cost. Ethernet has been used in the Boeing 777 to transmit non-flight-critical data and in the Boeing 767ER within a flight-critical display system. There are many safety concerns, however, when Ethernet is applied to flight-critical systems. The inherent nature of the Ethernet protocols can easily result in nondeterministic behavior and interference. These are significant technical hurdles that must be overcome before Ethernet will be a viable candidate as an aviation databus technology.

In this report, researchers summarize safety and certification issues of Ethernet-based aviation databuses. The research focuses on the issues of deterministic operations of Ethernet controller, device drivers, and communication stack, and possible solutions to avoid any adverse effects. For this study, the research team also determined evaluation criteria for the certifiability of Ethernet-based databuses and illustrated a prototype communication subsystem, to support deterministic

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data delivery in Ethernet. Using this proposed design as an example, the researchers describe how the specific avionics requirements can be satisfied. Finally, it describes the implementation of the design on a test bed and analysis of the final results.

Handbook for Ethernet-Based Aviation Databuses: Certification and Design Considerations (DOT/FAA/AR-05/54)

This handbook provides network designers and developers with some guidelines to develop an Ethernet databus framework deployable in aircraft avionics systems. It gives design rationale and requirements for the use of Ethernet-based networks in the avionics environment and identifies the relevant issues and concerns regarding the determinism of the databus system.

The handbook will aid in the process of qualifying an Ethernet-based databus as part of the overall aircraft certification. It focuses on identifying any and all aspects of the product that may impact its qualification. Some qualification issues related with Ethernet-based aviation databuses are discussed. The general acceptance criteria for the qualification of avionics databuses as well as the evaluation criteria specific to Ethernet-based databuses are discussed. The handbook describes the safety, performance, and reliability requirements of an Ethernet-based databus. Using the requirements of Ethernet-based databuses as a basis, the guidelines to design Ethernet-based aviation databuses and to address nondeterministic factors are illustrated.

This Handbook does not constitute FAA certification policy or guidance, but may be used as input to future policy and guidance.

Advanced Aircraft Materials, Engine Debris Penetration (DOT/FAA/AR-03/37)

This report documents the results of testing conducted at the Naval Air Warfare Center-Weapons Division, China Lake, California, as part of the continued effort to characterize uncontained engine events. The research team conducted this study in support of the FAA Aircraft Catastrophic Failure Prevention Program. Data generated from this test will support the penetration equation development for the Uncontained Engine Debris Damage Analysis Model (UEDDAM), a developmental design tool for conducting aircraft safety analysis for engine rotor burst events.

For this study, researchers investigated composite materials and metals for use in component shielding applications. Previous testing had focused on aircraft skins and structural components. They studied four materials: 2024-T351 aluminum; Ti-6Al-4V titanium; Inconel® 625 low-cycle fatigue; and a generalized composite. They used impact data from these materials to characterize the ballistic response via a material constant within the penetration equations.

Evaluation of a New Liquid Fire-Extinguishing Agent for Combustible Metal Fires (DOT/FAA/AR-TN06/26)

In this study, researchers evaluated a new liquid fire-extinguishing agent for combustible metal fires. Aircraft rescue fire fighters may confront metal fires, such as magnesium and titanium, in aircraft brake assemblies, landing gear components, aircraft engines, and other structural components of aircraft. A combustible metal on fire could be a possible ignition source or a continuing source of ignition in an aircraft fire. The standard method for extinguishing combustible metal fires consists of using sodium chloride dry powder to smother the burning metal.

The tests determined optimum chemical formulation, FEM-12 SC, and the best extinguishing method using 240 pounds per square inch, high-pressure extinguishers in a straight-stream configuration. The aquatic-toxicity test results showed that FEM-12 SC tested at 675 parts per million (ppm) median lethal concentrations was within the acceptable accuracy range of greater than 500 ppm. The extinguishing performance comparison results showed that sodium chloride extinguished a magnesium fire in an average of 102 seconds, twice as fast as FEM-12 SC. However, it created a potential long-term fire hazard because of its inability to cool the metal, which could redevelop into a fire. FEM-12 SC provided better cooling than sodium chloride so that the magnesium could be handled with bare hands within minutes of extinguishment. However, when FEM-12 SC came in direct contact with the burning magnesium, violent flare ups of the fire and flying magnesium sparks created potential fire hazards.

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