Federal Aviation Administration's

R&D Review

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ADDS: The Internet's Best Source for Aviation Weather

"When it comes to aviation, the bad news is that weather causes significant delays in the national aviation system," explains FAA's Aviation Weather Research Program lead Gloria Kulesa. "The good news, however, is that the FAA has been working long and hard with the aviation community to develop new and improved weather forecasting tools. And, we are making great progress. For example, to enhance pilot safety, we made operational weather data available on the Internet 24/7, via the Aviation Digital Data Service, called ADDS, at http://adds.aviationweather.gov/."

Because accurate, timely and user-friendly forecasts of icing, turbulence, thunderstorms, and clouds are required to support flight operations, the FAA's Aviation Weather Research Program is conducting applied research and development of state-of-the-art forecasts of these variables. The research team has developed a variety of tools to forecast adverse weather conditions. Some of these include:

- Current Icing Potential, which diagnoses current in-flight icing conditions
- Forecast Icing Potential, which forecasts potential in-flight icing conditions 3, 6, 9, and 12 hours into the future
- Graphical Turbulence Guidance, which predicts the location and intensity of clear air turbulence over the continental United States
- National Convective Weather Forecast (NCWF), which identifies current thunderstorm locations and predicts its location 1 hour into the future

ADDS integrates these and other tools, bringing new text, digital and graphical forecasts, analyses, and observations of the latest weather, plus forecasts of icing, turbulence, and thunderstorms to such aviation decision-makers as pilots, dispatchers, and airport ground crews. ADDS also provides comprehensive and high resolution of satellite and radar imagery.

Because weather information can be complex, ADDS tailors clear, concise, graphical information to individuals. For instance, users can plot their own route of flight and receive a pictorial display containing color-coded weather information for all altitudes, terrain, and other user-selected overlays. To access this feature, the user selects the Flight Path Tool option from the menu bar.

Users with other special needs can consult ADDS for an extensive array of interactive web features like raw text products tailored to specific requests,

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ADDS: The Internet's Best Source

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regional graphics with high resolution, and Java applets that enable full user customization. The system not only displays this information via static charts and text, but also incorporates visualization tools, using Java technology, to improve user understanding.

For pilot reports, AIRMETs, and SIGMETs,[1] the tool also allows users to limit the data to specified altitudes and time periods. Map overlays including counties, highways, and air route traffic control boundaries are available. The tool can also be set up to update automatically with new information.

For TAFs,[2] the Java tool can be used to zoom in on specific parts of the country. Black squares identify the location where TAFs are prepared. When the cursor is pointed to a square, the TAF text appears on the screen. In addition to the Java tool, ADDS breaks down the TAF information so the weather forecast derived from the TAFs is displayed at specified snapshots in time in hourly increments. This allows users to see the TAF forecast at many locations for a specific time.

For METARs,[3] the Java tool can zoom in on specific parts of the country. A station plot is plotted at each METAR location allowing the user to identify which observation appears (temperature, dew point, wind, altimeter setting, sky cover, color-coded flight category, ceiling, weather, visibility, and station identifier.) The tool automatically limits the number of stations displayed to avoid cluttering, but more or all can be added at the user's discretion. As the cursor covers a station, the full text METAR appears.

For national convective weather forecasts, the latest convection, or thunderstorm, a diagnostic is shown together with the 1-hour forecast. The Java tool allows the user to toggle the height and speed of the forecasted thunderstorm, as well as the 1-hour forecast from the previous hour to help the user understand how the forecast is performing. The user can zoom on a specific part of the country.

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1 Pilot reports (PIREPs) offer current weather conditions as reported by pilots who have just recently flown through an area. AIRMET is an acronym for "AIRman's METeorological information. It provides valuable information about the following conditions: moderate icing, moderate turbulence, sustained winds, 30 knots or greater at the surface, widespread area with a ceiling of less than 1,000 feet and/or visibility less than 3 miles, and extensive obscurement of mountains. SIGMETs, an acronym for SIGnificant METeorological information, are broadcast for hazardous weather that is considered of extreme importance to all aircraft. SIGMETs warn of the following weather hazards: severe icing, severe and extreme turbulence, dust storms, sandstorms or volcanic ash lowering visibility to less than 3 miles. A Convective SIGMET (WST) is issued for hazardous convective weather (such as tornadoes, thunderstorms, and hail) and covers severe or great turbulence, severe icing, and low-level wind shear. A Java tool can be used to zoom in on a specific part of the country and specify the type of hazard reported (e.g., icing, turbulence).

2 TAF is the international standard code format for terminal forecasts issued for airports.

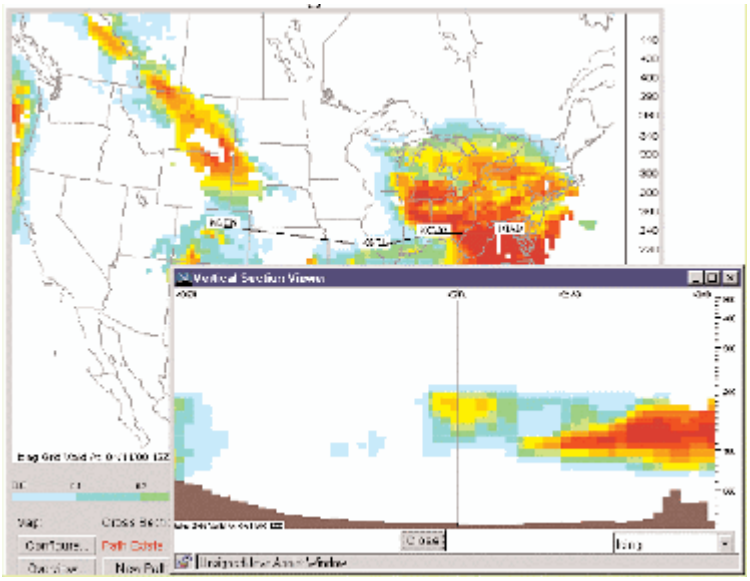
3 METAR is the international standard code format for hourly surface weather observations.

METARs and TAFs can also be overlaid and interrogated using the cursor. In addition, the user can overlay counties, highways, and air route traffic control boundaries.

Using the Flight Path Tool, the user can display color-coded weather data along a specific route of flight, for any applicable altitude. The display includes a depiction of the terrain, allowing the pilot to avoid obstacles related to weather or terrain. The flight path tool not only provides a suggested safe passage away from hazards, it also provides system efficiencies by designating airspace that is free of weather, reducing ground holds, and delays.

According to Kulesa, "Originally, we developed ADDS for the private pilot. We were pleasantly surprised, however, to see how popular ADDS has become with the airline dispatch and military communities, furthering our mission to increase system safety and capacity." Some of the comments the FAA has received include:

- Boeing 767 captain - "Best I've seen. I wish our product at work was as intuitive and useful."



- Dispatcher, major commercial carrier - "Are y'all sure you work for the government? ADDS is fantastic!"
- General aviation pilot - "ADDS is government at its best."
- General aviation pilot - "Frankly, I thought I'd never say this about a government Web service. The Java tools are incredible. I am stunned."
- General aviation pilot - "You folks are the best thing from the FAA in 20 years."

ADDS is a joint development effort of the National Oceanic and Atmospheric Administration Forecast Systems Laboratory, the National Center for Atmospheric Research, and the National Centers for Environmental Prediction Aviation Weather Center. The FAA's Aviation Weather Research Program provides the funding and direction for ADDS, and the system itself is operated by the National Weather Service.

The FAA's ADDS development team maintains an experimental web site to showcase new research at http://weather.aero. Upon maturity, these products migrate to the operational ADDS.❐

For additional information on the FAA's Aviation Weather Research Program, contact Gloria Kulesa at gloria.kulesa@faa.gov.

Editorial Notes

R&D Review is a publication of FAA's Operations Planning Aviation Research & Development Office, produced for and distributed to researchers from industry, academe, and government.

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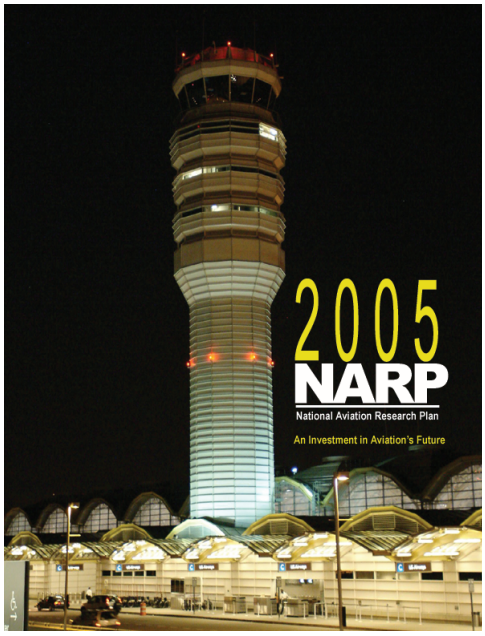
For questions or comments, please go to http://research.faa.gov

2005 National Aviation Research Plan



Each year, the FAA publishes the *National Aviation Research Plan* (NARP). The recently released 2005 NARP describes how R&D helps the FAA meet its near-term goals, while supporting the long-term needs of the aviation community. The document describes the R&D program, including its mission, vision, and budget, and shows how the R&D program achieves its objectives through various government, industry, and university partnerships.

The NARP also explains how the FAA evaluates its R&D programs to ensure that they are relevant, high quality, and well managed. Because aviation research is not the sole responsibility of the FAA, the plan also briefly outlines some of the R&D activities of other federal departments and agencies that contribute to the FAA goals and objectives.

For the first time, the NARP also defines FAA R&D strategies that address the major operational challenges facing the nation's air transportation system in the near- and long-term to increase safety, provide greater capacity, ensure international leadership, and achieve organizational excellence. These R&D strategies enable the FAA to focus its limited resources on the major safety and capacity challenges facing the aviation system over the next 5 to 10 years and help the Agency begin planning for the next generation aviation system.

In addition, the 2005 NARP highlights R&D program funding, evaluation, and accomplishments.

This year's plan builds on previous versions of the plan and provides a broader context for FAA R&D activities. Chapter 1 provides an overview of the plan.

Chapter 2 develops R&D strategies that will enable the FAA to address its near-term goals and objectives, as described in Flight Plan 2005-2009, and its long-term goals, as established by the Next Generation Air Transportation System Joint Planning and Development Office (JPDO). Chapter 3 describes how FAA R&D programs align with these goals.

Chapter 4 describes the FAA R&D program, including its mission, vision, and budget. It describes how the program achieves its objectives through various government, industry, and university partnerships. It also describes how the FAA evaluates its programs to ensure that they are relevant, high quality, and well managed. Last, Chapter 5 describes the roles and aviation-related R&D of federal departments and agencies that contribute to FAA goals and objectives.

Detailed information on the FAA R&D programs, FAA partnership and technology transfer activities, reviews by the Research, Engineering and Development Advisory Committee (REDAC), program assessments by the White House Office of Management and Budget (OMB), and acronyms and abbreviations are contained in Appendices A through E, respectively.❐

You can find the *National Aviation Research Plan* on-line at http://research.faa.gov.

EMAS Saves another Aircraft at JFK

2002 EMAS Save

For the third time, the engineered material arresting system (EMAS) at New York's John F. Kennedy International Airport (JFK) safely stopped a plane. On January 22, a Polar Air Cargo Boeing 747 landed and skidded off the end of runway 4R. The aircraft came to a rest in the middle of the arrestor bed, and no one was injured. The airport temporarily closed for arrivals while departures continued to use runway 4L.

"EMAS is proven technology that saves lives," said Joan Bauerlein, FAA's Director of Aviation Research and Development. "EMAS is also proof of the successful long-term public-private partnership of the FAA, Port Authority of New York and New Jersey, and Engineered Systems Company (ESCO)."

ESCO, the FAA, and the Port Authority of New York and New Jersey developed EMAS. Made of water, foam, and cement, the EMAS material "deforms" readily and reliably under the weight of an aircraft tire. As the tires crush the material, the drag forces decelerate the aircraft, bringing it to a safe stop.

JFK's runway 4R does not have the required 1,000-foot long safety area; Thurston Basin is 550 feet from the runway end. The Port Authority of New York and New Jersey worked with the FAA and ESCO to install an EMAS to provide overrun protection. The arrestor bed is 400 feet long, one of the larger sizes typical for a safety area of this length on a runway supporting large jet traffic.

Four years ago, the arrestor bed safely stopped an American Eagle commuter plane that overran a runway at the airport. All 30 on board walked off the aircraft. Damage to the aircraft was minimal. In June 2002, the EMAS stopped a cargo plane, carrying 3 crew, overran a runway while arriving at the airport, but no one was injured.

EMAS is now being installed at airports around the country, significantly enhancing the safety of the flying public. A single installation of EMAS is currently at airports in Barnstable Municipal Airport, Hyannis, Mass; Baton Rouge, La.; Burbank, Calif.; Dutchess County Airport, Poughkeepsie, N.Y.; Greenville Downtown Airport, Greenville, S.C.; Minneapolis/St. Paul, Minn.; New York (JFK), N.Y.; Regional/Woodrum Filed, Roanoke, Va.; and Rochester, N.Y. Two EMAS bed are installed, or are projected to be installed soon, at airports in Binghamton, N.Y.; Florida International Airport, Ft.

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1999 EMAS Save

FAA Studies Aircraft Lighting To Reduce Runway Incursions

Accidents happen, especially at night. So experts from the Airport Technology Research and Development program are trying to figure out why they happen, and how to prevent them.

For several nights this past winter, engineers recreated conditions blamed for a runway incursion, an event that happens when an aircraft, whether taking off or landing, comes too close to another plane, vehicle, person, or object on the ground. Now the FAA wants to know if certain lights, or combinations of lights, work better to alert all concerned about the presence of an aircraft on a runway.

The FAA is already making runways safer. A report released last summer shows incursions have dropped 20 percent over the past 4 years. Administrator Marion Blakey credits the success to FAA personnel, pilot awareness programs and new technology. But that is not enough. The agency's strategic *Flight Plan* still identifies reducing runway incursions as a critical safety objective. America's airports reported 32 serious incidents in 2004, compared to 67 in the year 2000. By 2009, officials hope to cut down the number of high-risk incursions annually to a maximum of 27.

"The Visual Guidance Program accepts that challenge," says Donald Gallagher, Visual Guidance Program Manager. Results from recent testing of different light configurations are being analyzed. In November, researchers spent 6 nights determining which existing lights make an aircraft more conspicuous to air traffic controllers and pilots, both on the ground and on approach.

The specialists took measurements and recorded reactions from professional pilots in two airplanes. In addition, they got another perspective from the view of air traffic controllers in the tower at Atlantic City International Airport.

Researchers evaluated landing lights, navigation lights, taxi lights, strobe lights, logo lights, and rotating beacons. The tests used standard aircraft lights either alone, or in various combinations. Some configurations were flashing, others burned steadily. Subjects were asked to judge the effectiveness of the configurations and to say which they deemed adequate or inadequate to avoid an obstacle on the runway.

The final report on aircraft conspicuity, which is expected soon, should result in accidents happening less frequently. The study is one of many ways the FAA Airport Safety Technology Section is working to enhance public safety. For information about the engineers' other projects, please visit http://www.airporttech.tc.faa.gov/.

Supporting the FAA Flight Plan

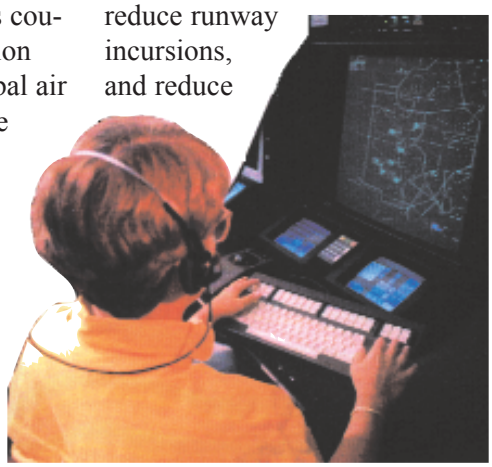
The potential of technology to improve the safety and efficiency of aviation can only be realized when human factors specialists remain the full partners of engineers. The promise of any new or improved system is largely dependent upon how successfully humans can work with the technology. Innovators must build knowledge of the strengths and weaknesses of human operators into their designs, and they must get this knowledge from human factors researchers. Realizing this dependency, the FAA requires human factors to be systematically integrated at the design, testing, and acquisition phases of new technologies being introduced into the national aviation system.

The critical role of human factors in achieving FAA's goals and mission is apparent in the Agency's *Flight Plan 2005-2010*. In fact, there are 12 human factors activities comprising a total of 31 performance targets contributing to the strategic and core business goals of the FAA and its lines of business in 2005. These activities represent a variety of research projects aimed at improving the performance of pilots, crews, inspectors, maintenance technicians, controllers, and system specialists. Through research in areas like selection, training, human-system integration, human error, and communication, human factors is helping to couple the most effective technology applications with advanced procedures. This coupling enables today's aviation workforce to make the global air transportation system of the future even safer and more efficient.

"Our focus is on assuring human performance can be maintained or improved compared to baseline levels as new technologies and procedures are introduced; we accomplish this by improving and standardizing methods for measuring that performance, gaining better insight into the factors that impact on performance, and translating the knowledge gained into standards and guidelines that will help enhance performance and mitigate human error," explains Dr. Paul Krois, acting program manager for Human Factors Research and Engineering. "Our mission is to provide the expert scientific and technical foundation derived across all aeronautical human factors research and development programs to support the broad-based research application efforts responsible to FAA operational, regulatory, and acquisition functions."

Safety

In the safety arena, human factors researchers are involved in several projects that will help ensure the Agency meets its Fiscal Year (FY) 2005 safety goal. These projects are designed to improve commercial and general aviation safety, reduce runway incursions, and reduce air traffic control operational errors.



A good example in support of the FAA's goal to increase commercial aviation safety is the continuing enhancement of the human factors certification job aid. Human errors have been cited as significant contributors to aircraft accidents. Until recently, however, there has been no effective mechanism for those involved in the certification of aircraft flight decks to identify and cross-reference human factors issues, regulations, guidance material, policies, and other relevant information. Prior to the latest job aid enhancements, individuals relied on their personal experience and domain knowledge to tie all of this information together. When fully developed, the job aid will allow certification team members to retrieve, search, and cross-reference the following information related to flight deck human factors:

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Did You Know?

FAA Research Reports Are On-line

FAA researchers are pleased to make their research and development results available to the public, at no cost, on the Internet.

Although, there is currently no central repository for FAA research and technical reports, many of the Agency's R&D organizations, located across the country, report their findings on their individual websites.

To access technical reports done by the Office of Aviation Research and Development, please go to http://research.faa.gov/tech_reports.asp. This website contains reports dating from 1998-2004. Some earlier reports can be found at http://actlibrary.tc.faa.gov/.

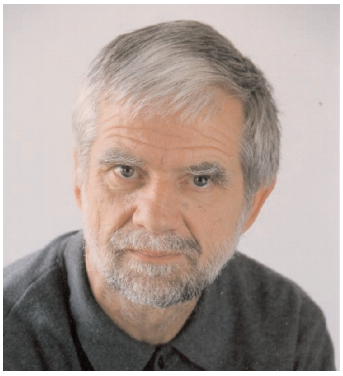
Reports recently added to the R&D library include:

- *An Evaluation of the Flammability of Aircraft Wiring Commuter Aircraft Video Landing Parameter Surveys, Summary Report-London City Airport, Philadelphia International Airport, And Atlantic City International Airport*
- *Material Testing Research and Indenter Equipment Modifications for Determining Aging of Wires (Cables) in Aircraft*
- *Evaluation and Verification of Advanced Methods to Assess Multiple-Site Damage of Aircraft Structure*
- *Comparison of Various Impedance Measurement Techniques for Assessing Degradation in Wiring Harness Shield Effectiveness and a Field Survey of Fadec Shield Integrity of In-Service Aircraft*
- *Shield Degradation Effects of Loosened Connector Backshells of Aircraft Wiring Harnesses*

Research results from the FAA's William J. Hughes Technical Center are found at http://actlibrary.tc.faa.gov/. Reports from the Civil Aerospace Medical Institute are on-line at http://www.cami.jccbi.gov/aam-400A/Abstracts/Tech_Rep.htm. The published results of work done for the FAA by the VOLPE National Transportation Systems Center are found at http://www.volpe.dot.gov/library/index.html.

If you need a report that you cannot find on-line, please contact the Office of Aviation Research and Development at http://research.faa.gov. We will do all we can to make that report available to you as soon as possible.❐

FAA-Sponsored Researcher Wins Award



The Flight Safety Foundation recently notified the FAA's Human Factors Research and Engineering program office that their nominee, Dr. Christopher Wickens, a long-time FAA research partner, had been selected for the 2005 Flight Safety Foundation/Airbus Human Factors award.

Dr. Wickens' primary research interests have focused on the relevance of principles and theories of human attention to the design of complex systems, particularly aviation systems with which humans frequently interact. The breadth of this research activity is made possible through multiple affiliations and partnerships with government, industry, and academic organizations in the joint conduct of aviation research.

Through his groundbreaking research in aviation human factors, Dr. Wickens has made significant safety contributions to both military and civil aviation. For more than three decades, he has supported the nation's aviation safety goals through applied aviation research activities in the filed of human factors. Working with both government and industry, he has made valuable contributions in aircraft flight operations, flight training, simulation technology, and aviation education.

As head of the Aviation Research Laboratory at the University of Illinois, Professor Wickens' leadership has produced significant findings in theoretical and applied areas of research involving aircraft flight operations, flight training, simulation technology, and aviation education. His applied research has brought changes in heads-up displays, while his theoretical research has increased our knowledge of human attention and cognition. His impact on the aviation research community has been pervasive and broad-based.

This honoree has authored or co-authored seven textbooks, 146 articles or book chapters, 152 technical reports, 200 publications from professional meetings and presentations, and has given 75 symposia or invited presentations. In 1997 and 1998, as chair of the FAA's Panel on Human Factors in Air Traffic Control Automation, Dr. Wickens co-authored *Flight to the Future: Human Factors in Air Traffic Control* and *The Future of Air Traffic Control: Human Operators and Automation*, published by the National Academy of Science.

Christopher Wickens received his Ph.D. from the University of Michigan in 1974. He recently retired from the University of Illinois at Urbana-Champaign, as Professor of Psychology, head of the Aviation Research Laboratory, and associate director of the Institute of Aviation. He remains a part-time faculty member in the Beckman Institute Human Perception and Performance group.

Previous honors for Dr. Wickens' human factors research have been numerous and impressive. Among them are: Henry Taylor Founders Award, Aviation, Space, and Environmental Medicine Association (2000); FAA Excellence in Aviation Award (2000); Finalist for Luckman Award for Undergraduate Instruction, UIUC (1995); Franklin Taylor Award from the Division of Applied and Engineering Psychology, American Psychological Association (1994); Paul M. Fitts Award from the Human Factors Society for outstanding contributions to the training and education of human factors specialists, (1985); Psi-Chi Award for teaching in Psychology (1984); Jerome Ely Award from the Human Factors Society for best article in Human Factors Journal (1980); Fellow of the Human Factors Society.❐

Supporting New International Pavement Standards

In 1993, with little more than a vision of what the next generation aircraft might look like, FAA airport pavement researchers invited other government, military, industry, trade, and international aviation officials, to participate in a new Airport Pavement Working Group. Realizing that airport pavement design standards, adapted from highway pavement design, might be insufficient to support the new civil and military aircraft then being designed, working group participants committed to advancing airport pavement science and engineering to ensure future aviation needs could be met.

"The Airport Pavement Working Group provides a forum for airport pavement experts and aviation decision and policy makers to discuss and concur on proposed pavement standards and tools," explains Dr. Satish Agrawal, manager of FAA's airport technology R&D program. "Our first meeting in 1993 had only 10 participants, today the group encompasses over 50 representatives from government, academia, industry (Boeing and Airbus), trade groups, and international researchers and government representatives from France, Canada, Israel, Australia, England, Russia, China, and Japan. The Working Group now meets 3 times in a 2-year period to exchange information and to work together to harmonize pavement design standards."

As aircraft get bigger and heavier, with new kinds of landing gear, added stresses and strains are exerted on airport pavements. New aircraft, such as Boeing 777 and Airbus A-380, necessitate the development of new pavement design procedures (thickness requirements). The Boeing 777, which entered commercial service in June 1995, for example, has two, 6-wheel main landing gears to support a gross weight of up to 752,000 pounds. The 6-wheel gear loads applied to airport pavements by the Boeing 777 and the new Airbus 380 (due to enter commercial service in 2006) are different from the loads applied by the 4-wheel main landing gear of the older generation of commercial airplanes.

Construction of new pavement, however, represents a huge investment. There are approximately 650 million square yards of runaway pavement surface in the United States alone, with an estimated replacement value of over $100 billion. The Federal Government and the aviation community currently spend approximately $4 billion annually in replacing, repaving, rehabilitating, repairing, and maintaining these pavement surfaces. Airports must carefully plan for the construction of new pavements, refurbishment and/or upgrade of existing pavements, as well as ongoing pavement maintenance activities.

The planning, design, and construction of economical and durable pavement requires an understanding of a variety of factors in determining the type and optimum thickness of pavement layers. Technology cannot yet provide means of understanding the behavior of pavements subjected to aircraft loading so the behavior must be found through full-scale testing. Such testing involves the controlled application of simulated aircraft gears at realistic tire loads to a full-scale layered, structural pavement system. The purpose is to determine pavement response and performance under a controlled, accelerated, accumulation of damage in a compressed time period.

"The Working Group meetings provide the opportunity for national and international pavement experts to discuss ongoing research and test data, research plans, and outcomes," explains Dr. Agrawal. "The

FAA is leading the world in pioneering new pavement design tools, validating new theories, and conducting basic scientific research. Because this work has international ramifications, the Working Group acts as a peer reviewer for the FAA's research work, helping to provide scientific validity to the work being done at the FAA's National Airport Pavement Test facility, a full-scale pavement test facility dedicated solely to airport pavement research." Built under a cooperative research and development agreement with the Boeing Company, the facility provides high quality, accelerated test data on rigid and flexible pavements subjected to simulated aircraft traffic. This work is becoming even more critical as the next generation of heavier aircraft begin to enter commercial service.

Using data collected from the FAA's National Airport Pavement Test Facility, FAA researchers are developing criteria and methods for design, evaluation, performance, and serviceability of airport pavements. At the most recent Working Group meeting, FAA researchers discussed their new design procedures, asking for input and concurrence from group members. Input from international partners is critical, since FAA's technical data is helping to validate new design standards and assure compatibility between aircraft and airports throughout the world. The data is also providing the FAA an improved scientific basis for further development, which will assist the refinement of the International Civil Aviation Organization ICAO's pavement loading standards for aircraft. New international standards are expected in 2007.

Because of the critical need to understand better pavement behavior, the FAA has made its test data available on-line at

http://www.airporttech.tc.faa.gov/naptf/.❐

Further information on the National Airport Pavement Test Facility can also be found at the website listed above. To obtain a copy of the briefings presented at the last Pavement Working Group meeting, please contact Barbara Davenport at barbara.davenport@faa.gov.

FAA Debuts On-Line Human Factors Training

To ensure adequate human factors training is readily available, the FAA has launched an on-line "Human Factors Awareness Course." The purpose of this course is to introduce the concepts of methods of the human factors discipline. While developed specifically for those who support FAA system acquisitions, the course is open to all, including the general public. FAA employees are eligible for a Certificate of Training upon course completion. The goal of this ten-module course is to foster an understanding of the role and contribution of Human Factors in system design, development, and implementation. "Improvements to aviation safety and capacity are dependent on developing a national aviation system that is not only technically sophisticated, but also human performance-based and human-centered," says Joan Bauerlein, FAA Director of Aviation Research and Development. "That is why the FAA requires that human factors be systematically integrated at each critical step in the design, testing, and acquisition of new technology intro-

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Supporting the FAA Flight Plan

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- **Regulations**
- **Advisory circulars**
- **Policies**
- **Technical Standards Orders**
- **Industry standards**
- **Human factors topics and issues**
- **Flight deck component descriptions**
- **Human factors considerations related to the areas of flight deck certification**
- **Human factors research results and findings**

The job aid will facilitate a more thorough and effective design review and certification, ensuring that safety-related human factors issues are resolved prior to design approval. The tool will also allow FAA certification personnel to review more effectively the designs, and identify and resolve human factors issues, relying on human factors specialists only when necessary. Public access to the job aid will also allow applicants to manage key issues more effectively at the early design stages, reducing the need for late changes in the designs, and thereby cutting both development cost and certification risk.

The human factors program is working with industry to develop FAA/industry training standards for general aviation pilots. Several people from industry, academia, and the FAA believe general aviation training programs lack the flexibility to adapt to the diverse aviation technologies (such innovations as GPS, multifunction displays with moving map navigation, and traffic, weather, and terrain avoidance systems) that have recently entered the national airspace.

In the past, related systems have functioned and looked alike. Now systems that perform similar functions do not necessarily resemble one another, but pilots may be required to interact differently with each of them.

Consequently, a "one-size-fits-all" approach to training may no longer be either adequate or appropriate.

FAA/industry training standards will attempt to overcome the limitations of existing training programs by collaborating with industry to develop new and innovative training methods to ensure that pilots are trained and maintain proficiency in aircraft that contain new technology. New training methods emphasize improved risk management, training and education, and proper use of each new technology. In FY 2005, human factors specialists will complete research and make recommendations for pilot proficiency standards. Human factors researchers are also supporting the safety office in the Air Traffic Organization, in developing the Runway Incursion Severity Categorization model. This tool helps safety personnel assign more objective and reliable ratings of severity to runway incursion incidents. The model leverages expert knowledge in the form of specific incursion scenarios and relevant factors. Based on the expert-group rating system currently in use, it provides a more valid and reliable assessment of incursion severity and is being considered as an international standard for rating this severity. In FY 2005, human factors specialists will validate the model with data from additional incidents and then begin operating it in a shadow-mode to obtain real-time data.

As part of the Agency's air traffic research, human factors experts will continue, in FY 2005, to develop a better understanding of the relationship between human factors and air traffic system safety. Researchers are using the JANUS technique to understand the role of cognitive, situational, and work-related factors as they influence the performance of operational air traffic controllers and its possible effect upon the occurrence of operational errors. The JANUS technique uses a computerized questionnaire to gain a better understanding of the situational context in which a series of critical decisions, or a chain of events, can result in error. In FY 2005, human factors specialists will continue collecting operational error data at terminal and en route facilities and begin evaluation of a web-based JANUS tool.

Organizational Excellence

Human factors research helps to understand the complex relationships between employee attitudes and organizational performance, which, in turn, helps to establish a foundation for developing a suite of strategic human capital metrics. This research is helping the FAA to achieve its organizational excellence goal, specifically in the area of leadership.

In achieving this *Flight Plan 2005-2010* goal, the Agency will be better able to manage its effectiveness and accountability, to increase the commitment of individual workers to accomplish the full gamut of agency goals, and will ensure a better prepared and diverse workforce.

Researchers are developing a web-based employee attitude survey tool to be used in the next survey in FY 2006, and are developing an on-line data warehouse for the collection and analysis of survey data.

These are just a few of the human factors activities now underway that are ensuring the FAA meets is goals. To find more about the work being done by the FAA's human factors specialists, please visit http://www.hf.faa.gov.❐

FAA Debuts On-Line Training

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duced into the national aviation system."

The beneficiaries of FAA's ongoing human factors program are widespread across both government and industry. Within government, safety specialists are gaining a better knowledge of how aircraft flight deck and cabin design features, as well as training and operational procedures, affect human performance and safety. Technical operations experts are acquiring the information required to procure and operate efficient error-resistant systems, and air traffic controllers are being provided decision support systems that will improve safety and increase throughput to accommodate the higher traffic levels projected for the future.

In addition, manufacturers have gained the knowledge and information required to develop systems that operate effectively within the global air transportation system. Air carriers are achieving the ability to apply more effective personnel selection and training programs. General aviation is receiving equipment and procedures that enhance safe operation at lower costs.

The training is available at http://www.hf.faa.gov/webtraining/index.htm. More in-depth information on specific FAA Human Factors programs and research can be found at http://www.hf.faa.gov.

Guidance on the role of Human Factors in FAA acquisition programs can be found at http://www.hf.faa.gov/tools.htm.❐

FAA Researchers Earn Patent

FAA fire safety researchers Dave Blake and Rich Lyon recently received a U.S. patent for an invention that will help increase aircraft safety.

The Problem

Fires in aircraft cargo holds are difficult to detect before they reach the stage where they endanger the safety of the aircraft. Sometimes cargo fires begin slowly in the bottom of the hold, generating gases with little or no flames, heat, or visible smoke for a considerable length of time. A reliable detector for this early stage of fire development would provide additional time for a safe landing.

The fire detectors currently used in aircraft, optical cargo hold detectors, are made to detect visible products of combustion (smoke) that are generated at the later stages of a fire when it may be too late to land the airplane. Hoping to detect cargo fires earlier, operators often set optical fire detectors at a high sensitivity level. When particles of dust of moisture get inside the detector chamber, false alarms can result. Frequent false alarms involving cargo compartments have become a nuisance and persistent problem, with approximately 200 false alarms for every real fire detected.

Researchers believe that combining signals from gas and temperature sensors with information from existing smoke detectors could screen out nuisance alarms and allow for the early detection of actual cargo fires. Despite the potential significant safety benefits, no design standard is now available for the use of these additional sensing detectors in aircraft cargo holds.

To solve this problem, aircraft manufacturers need to know what types of gases the new sensors must be designed to detect. The standards for residential smoke detectors are inappropriate for aviation purposes, for they are based on tests using shredded newspaper, wood, or flammable liquids as the burning substances. Because of the mix of materials in the hold, the composition of the gases generated by a cargo fire can vary over wide ranges making it difficult for manufacturers to know what exactly to design their detection systems to respond to. Similarly, the variety of plastics and other

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EMAS Saves Another Aircraft

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Lauderdale, Fla.; Little Rock, Ark.; and New York's LaGuardia. Additional EMAS are now under design and FAA review, and international interest is increasing.

Generally, the cost to install an EMAS ranges between $2 million and $4 million, plus site preparation, for U.S. installations. Airports can apply to the FAA for Airport Improvement Program (AIP) grants to help defray the cost of the system.

The FAA is currently working with ESCO to install an EMAS test bed at its William J. Hughes Technical Center in Atlantic City, N.J. The test bed will allow researchers to monitor environmental effects on EMAS durability, improve installation methods, and improve computer modeling. The FAA expects to complete the installation of the test bed in 2005.❐

Center of Excellence Student of the Year

L to R: Ian Waitz, MIT, Director, COE for Aircraft Noise and Aviation Emissions Mitigation (PARTNER) and Stephen Lukachko.

Each year at the annual meeting of the Transportation Research Board, the Department of Transportation (DOT) honors the achievements, contributions to the transportation field, and future promise of students from its participating University Transportation Centers. Students from each center are selected based on their accomplishments in areas such as technical merit and research, academic performance, professionalism, and leadership.

This year, the Department again honored a student from the FAA Air Transportation Centers of Excellence program. Stephen Lukachko, the sixth COE student recognized by DOT, was also recognized by as the FAA Center of Excellence (COE) Outstanding Student of the Year at the COE 4th Annual Joint Meeting in Orlando, Fla. on March 15.

Stephen is a doctoral candidate and Sir Frank Whittle Fellow at Massachusetts Institute of Technology (MIT), Department of Aeronautics and Astronautics. Since earning his bachelor's degree in 1992, he has worked for NASA Langley Research Center, the National Research Council, and MIT's Gas Turbine Laboratory. His research interests include thermo-fluid-chemical systems (energy conversion, combustion, and emissions), strategic decision-making (design for social value; value definition, risk and uncertainty), and environmental policy (noise and emissions impact, mitigation, and policy design).

Stephen has authored 14 publications as well as many reports. He has also served as a consultant for the United Nation's Intergovernmental Panel on Climate Change and the National Research Council.

DOT selected Stephen specifically for his work with the FAA Center of Excellence for Aircraft Noise and Aviation Emissions Mitigation (PARTNER) to develop a methodology for probabilistic estimation of environmental costs associated with air transportation. He developed a multi-attribute impact pathway analysis to probabilistically estimate emissions and noise inventories, health and welfare risks to people and ecosystems, and a damage function for environmental costs from air transport operations. The FAA will use his methodology to identify environmental risks, clarify interdependencies, and determine economic consequences. The FAA expects to make use of this important research to inform policy decisions considered by the International Civil Aviation Organization.❐

For further information about the FAA COE Program, see www.coe.faa.gov or contact Patricia Watts, FAA COE Program Director at (609) 485-5043.

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materials used in clothing and consumer packaging, make the emissions from the burning holds of most passenger aircraft highly complex.

From an aviation safety perspective, it is not feasible to allow each detector manufacturer to use a different combustion test sample, since this would lead to an undesirable variation in the performance of detectors.

The Solution

To ensure the effectiveness of aircraft cargo detectors to detect both smoldering (early stage) and flaming (late stage) fires, FAA researchers Dave Blake and Richard Lyon designed a test that can simulate either type of fire. They also developed a reference combustion test sample that closely generates the same mixture of products of combustion that would be found in a fire in an aircraft cargo hold.

To develop a sample that generates the heat, visible smoke, and gases that typify a cargo compartment fire under simulated smoldering or flaming conditions, Blake and Lyon combined a mixture of pellets of the plastics usually found in aircraft cargo compartments and compression molded them into a 4 x 4 x 3/8-inch sample with a heating element embedded in the center. When they initially energized the heating element, Blake and Lyon found that the layers of pellets began to smolder, thereby simulating the generation of invisible gases like those accompanying the early stages of a cargo fire. Turning up the heater power, or adding a small amount of flammable liquid, caused the sample to burst into flames and generate the visible smoke typical of the later stages of a cargo fire.

With samples developed by Blake and Lyon, researchers can now generate the entire combustion sequence of cargo fire product formation in a controlled, reproducible manner. Ongoing tests will find ways to discriminate between real fires and nuisance alarm sources and optimize the design of detectors for early and reliable fire detection.

United States Patent No. 6,812,834 was awarded on November 2, 2004, for a reference sample for generating smoky atmosphere. Richard Lyon holds two other patents for his fire safety work.❐

Call for Nominations for FAA Excellence in Aviation Research Award

The FAA is accepting nominations for its annual Excellence in Aviation Research Award. Through this award, the FAA acknowledges the valuable contributions of its external research partners and formally recognizes significant aviation research accomplishments. Conferring this special distinction allows the government to recognize superior research efforts and bring their benefits to public attention.

The Excellence in Aviation designation is a highly competitive, non-monetary award that is presented each year to worthy individuals or institutions.

Nominees must be able to show significant impact and benefit of extended aviation research efforts and application of improvements within the aviation industry.

This is the eighth year that the agency will be presenting this prestigious award. Each year, the nominee pool has grown, reflecting a broad spectrum of aviation-related research activities. Nominations and supporting documentation for the 2005 Excellence in Aviation Research Award will be accepted through June 15, 2004. For additional information on the award, please go to **http://research.faa.gov** or contact Dr. Terry Kraus at terry.kraus@faa.gov.