

## 2.2 Airports Technology Program Area Description

### Mission

The Airport Technology program mission is to enable the nation's airports to accommodate projected traffic growth within an operational environment free of accidents and fatalities. The Agency's regulatory obligation, under 49 U.S.C. 47105(b) 3, is key to achieving this mission. The development and promulgation of standards, criteria, and guidelines provide technology solutions that affect the plan, design, construction, operation, and maintenance of the massive airport system.

Each year, the U.S. airport system logs over 600 million passenger enplanements at over 17,000 landing facilities with terminal buildings and access roads. Today's system consists of six billion square feet of pavement with a replacement value estimated at \$100 billion. Current trends indicate that, by the year 2010, air traffic demands will double. The aircraft fleet will certainly grow in number; but more significantly, individual aircraft will increase in size, operating speed, gear loading, and configuration. To deal safely with greater numbers of more demanding aircraft, airport pavements will need capital improvements costing billions of dollars.

The program's areas of focus include:

- Airport pavement design
- Airfield design
- Wildlife control and hazard mitigation
- Runway incursions
- Visual guidance systems
- Surface traction
- Post-crash rescue and firefighting

### Intended Outcomes

The most important program outcomes are reducing or eliminating aircraft accidents and lowering the cost of developing and maintaining safe airports.

The Airport Technology program area supports several FAA Strategic Plan goals:

- *System Safety*: Reduce the number of accidents and incidents occurring on or near the airport surface. Current areas of emphasis involve the reduction of incidents in which air-

port surface condition is a cause or factor, reduction of hazards from wildlife strikes, and reduction of runway incursions and runway transgressions.

- *System Capacity*: Enhance airport capacity.
- *Industry Vitality*: Enhance the vitality and international competitiveness of the U.S. commercial air transportation industry.
- *Global Leadership*: In cooperation with industry and other Federal agencies, promote U.S. aviation system technologies.
- *Environmental Responsibility*: Create an environmentally effective and responsive FAA both domestically and internationally.

**System Safety** — A comprehensive R&D program targets the reduction or elimination of aircraft accidents and incidents. The program seeks to reduce the risk of aircraft sliding off runways due to the presence of water, snow, and ice, or other surface contaminants such as rubber and anti-icing materials. Improved runway traction through use of improved methods, materials, and procedures for detecting and removing contaminants from runway surfaces is the central focus of this research.

The program is developing national standards for the design of soft-material arrester beds. Although these devices have already been proven effective in stopping an overrunning aircraft, more economical materials and installation methods must be found to encourage their increased use.

Ongoing research in the area of wildlife control at or near airports seeks methods of reducing hazards from wildlife strikes with aircraft. These efforts include cooperative research with the Department of Agriculture in assessing wildlife hazards at airports and maintaining a national bird strike database.

Continued research in visual guidance systems is necessary to improve the safety of ground operations during daytime, nighttime, and under low-visibility conditions. Pilots and vehicle operators must receive clear and unambiguous information from lights, signs, and markings. Improvements in this area will help eliminate runway incursions and aircraft collisions on airport surfaces. State-

of-the-art light sources and applications are necessary to enhance the safety and efficiency of aircraft operations.

***Industry Vitality, Global Leadership, and System Capacity*** — A comprehensive airport pavement design research and development (R&D) program is directed toward the achievement of these agency goals. The program receives broad based support from the U.S. and international governments as well as the collaboration of industry. The International Civil Aviation Organization (ICAO) has formally agreed to use the results from the Airport Technology program to develop worldwide pavement design standards.

The FAA's pavement research has the potential to provide large benefits. Each year, approximately \$2 billion is spent by airport operators in conjunction with federal, state, and local governments to construct, rehabilitate, and maintain airport pavements. About \$4 million is spent annually on research. Increasing the pavement life by as little as ten percent through research would result in a 50 to 1 benefit/cost ratio. The program is working to achieve this attainable goal.

ICAO relies heavily on the results of visual aids research performed in the United States. An increasing amount of visual aids research is being performed here in cooperation with the United Kingdom and other European countries in order to reduce costs and to develop uniform international standards.

Research efforts are required to develop strategies for attacking post-crash fires on the new multi-level, high-density seating, passenger aircraft being designed by manufacturers around the world. Elevated waterway and boom penetration devices are examples of ways to provide increased passenger survivability and evacuation protection. Training requirements and firefighting simulators must still be developed to fully utilize the new capabilities. ICAO is using research results to develop international firefighting standards.

### **Program Area Outputs**

The airport advisory circular system is the FAA's principal means of communicating with the the Nation's airport planners, designers, operators, and equipment manufacturers. Advisory Circulars (AC) publish the standards used in the design,

construction, installation, maintenance, and operation of airports and airport equipment. In all projects funded through the Airport Improvement Program (AIP), project work must meet standards set in one of these ACs. Requirements for pavement construction to meet standards for design, performance, and durability ensure that the \$100 billion investment in airport pavement is protected. In addition, ACs provide information that promotes safe and efficient operation under adverse weather conditions.

Over 100 ACs have been published on a wide range of technical subjects, including airport design configuration standards, pavement design and material, lighting and navigational aids, fire-fighting equipment and procedures, pavement condition weather sensors, wildlife control, terminal building design, snow/ice control, and equipment and procedures for measuring friction.

The FAA updates ACs, as needed, through information and data collected in the entire Airport Technology R&D program.

### **Program Area Structure**

Various elements of the Airport Technology program area affect the safety and operation of aircraft at or near the airport. Factors that determine the eventual safety of a flight include:

- Push-back from gate
- Movement on aprons, holding bays, deicing pads, etc.
- Taxi to/from runway
- Visibility conditions
- Pavement configuration
- Lighting, markings, and signs to guide the aircraft to/from the runway
- Other ground traffic
- Runway surface conditions
- Presence of birds or deer
- Available overrun area beyond the ends of the runway
- Pavement structural integrity

In addition, the potential of rejected takeoff and possible rescue efforts is a safety concern associated with every flight. This program area systematically addresses these issues with a single deter-

mination to establish an operational environment that is free of accidents and fatalities.

### **Customer and Stakeholder Involvement**

Airport Technology's major projects support the overall FAA mission of fostering a safe and efficient airport system. Runway traction research directly supports the FAA Challenge 2000 recommendation to develop new technologies and standards for runway friction measurement and safety overrun arrester systems.

Several issues in the Aviation Safety Plan are supported by Airport Technology research. These include preventing runway incursions; improving takeoff and landing performance monitoring; developing environmentally acceptable alternatives for deicing and anti-icing agents; and improving ground navigation technologies, planning, standards, signage, and procedures.

Airport Technology rescue and firefighting research supports an ICAO initiative to replace environmentally harmful Halon 1211 for extinguishing engine fires and other fuel fires.

Aircraft manufacturers and the FAA urgently need new pavement design standards for operating next generation heavy aircraft. Manufacturers need them to ensure compatibility of their aircraft on airport surfaces throughout the world. The FAA needs them to assure the public that federal funds for rebuilding or strengthening runways are being judiciously spent to protect the \$100 billion infrastructure investment.

These standards will be developed from data being collected on the National Airport Pavement Test Machine—the first-ever of its kind—over the next ten years. Both the FAA and the Boeing Company are stakeholders in this important project. Financed through a cooperative R&D agreement between the FAA and the Boeing Company, the design and construction of the machine has been completed and operation of the testing facility began in June 1999. Boeing provided \$7 million (one-third of the total cost) towards its completion. The FAA, Boeing, and ICAO will develop pavement design standards for ensuring aircraft-airport compatibility on a worldwide basis.

### **Accomplishments**

During the past five years, the Airport Technology Program has provided products that have enhanced the safety of aircraft operations in the United States and around the world. Ongoing research will save the public billions of dollars and protect the environment while attempting to provide an operational environment free of accidents and fatalities.

The program has provided an engineering solution to aircraft overruns by developing the engineered materials arresting system. The Port Authorities of New York and New Jersey have authorized installation of up to five systems at New York airports at a cost of \$4.5 million. The first installation was completed in December 1996 at John F. Kennedy Airport. The May 8, 1999 overrun of Eagle Saab 340 at JFK, with its arrestment and rescue of all 27 passengers and crew of three, is a prime example of payoff of our research in the engineered materials arresting systems.

The Airport Technology Program has developed a concept for an advanced taxiway system that is expected to reduce inadvertent aircraft incursions when demonstrated in the field in FY 2001. The system controls taxiway lights and signs without inputs from radar devices to guide aircraft automatically to and from runways and ramps during low-visibility conditions.

The program has enhanced the performance of pavement markings (visibility, durability, and skid resistance) by adding retro-reflective glass beads and silica. Work also has advanced on a new Driver's Enhanced Vision System that allows airport rescue and firefighting vehicles to navigate through fog, rain, sleet, and snow. This technology enables quick and effective response to crash sites. Several airports around the country have adopted this technology for their rescue vehicles.

A new pavement design standard has been introduced through the program to allow the new Boeing 777 to operate without weight penalties on existing pavements. Without this standard, hundreds of millions of dollars would have been needed to strengthen U.S. airport pavements.

The Airport Technology Program also has successfully tested an innovative technology for air-

craft deicing using infrared energy. The first air transport category installation became operational at Newark International Airport in February 2000. This technology offers potential cost savings over conventional methods.

### **R&D Partnerships**

The Airport Technology Program is committed to working closely with airport operators and experts from all branches of the aviation industry and with existing expertise and facilities in the Department of Defense, academics, highway sectors, foreign countries, and the ICAO. The program developed several cost-effective partnerships and agreements, including:

- FAA-U.S. Army Waterways Experiment Station, Interagency Agreement (Pavement).
- FAA-U.S. Air Force, Tyndall Air Force Base, Interagency Agreement (Aircraft Rescue and Fire Fighting).
- FAA-University of Illinois/Northwestern University, Center-of-Excellence for Airport Pavement Research, Partnership through matching funds.
- FAA-Boeing Company, Cooperative Research and Development Agreement, Partnership through \$7 million influx from Boeing towards the test machine.
- FAA-Canada (Public Works and Government Services) Project Arrangement for cooperative research in pavement technology.
- FAA-National Aeronautics and Space Administration (NASA) Memorandum of Un-

derstanding for joint runway traction research.

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

### **Long-Range View**

Support for friction testing of new products to eliminate slipperiness as a cause of accidents will continue beyond 2005. Operation of FAA's national pavement test facility began in June 1999 and will continue for ten years. The data collected from the test machine will allow smooth introduction of new heavy aircraft expected to join the fleet well into the next century. The pavement design standards based on these data will:

- Provide assurance to manufacturers about the compatibility of their aircraft with airports throughout the world.
- Provide airport operators precise costs estimates to permit new aircraft operations at their facilities.
- Allow airlines to plan for new equipment and routes.
- Give airport designers confidence in their designs.

This long-range commitment to improving airport technology gives the FAA the tools required ensuring the public that federal funds are being judiciously spent and that public investment in infrastructure is prudently managed..

## Airport Technology

**Intended Outcomes:** The FAA intends to improve airport system safety, efficiency, and capacity through advancements in aircraft technology and air traffic control systems. The FAA will also develop and maintain standards in all airport system areas to:

- Reduce aircraft accidents due to incursions, particularly in low-visibility conditions.
- Reduce aircraft accidents due to slipperiness caused by ice and snow on runways.
- Reduce environmental impacts due to chemical usage on airports during winter operations.
- Reduce the massive investment required for pavements.
- Improve post-crash rescue and firefighting capabilities.
- Reduce the negative impact of wildlife on airport safety.

**Agency Outputs:** The FAA is required by law to develop standards and guidance material for airport design, construction, and maintenance. The FAA uses the airport Advisory Circular (AC) system as its principal means of communicating with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers. ACs cover airport geometric design, pavement design, safety areas, visual aids, access roads, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices enforce standards and guiding material when administering the Airport Improvement Program (AIP).

The Airport Technology program provides the technical information necessary to support and update these agency outputs in a timely manner.

**Customer/Stakeholder Involvement:** Approximately \$2 billion is spent annually to provide operationally safe and reliable airport pavements. The FAA provides about half of this amount as AIP grants; state and local

governments and airport operators provide the remainder. Projects funded under the AIP grants must conform to the FAA ACs or standards.

Aircraft manufacturers need new pavement design standards for operation of next-generation heavy aircraft to ensure compatibility of their aircraft with airport surfaces throughout the world. To accomplish this, the FAA and the Boeing Company have entered into a Cooperative Research and Development Agreement to build a unique full-scale pavement test facility at the agency's William J. Hughes Technical Center. The FAA, the Boeing Company, and the International Civil Aviation Organization (ICAO) will use data collected from the project in developing international pavement design standards.

The FAA needs these standards to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent and also to protect the \$100 billion investment in the U.S. infrastructure.

**Accomplishments:** During the past five years, the Airport Technology research program has provided products to enhance the safety of aircraft operations in the United States and around the world. Research results are published as FAA ACs and made available to users worldwide. Some major accomplishments are:

- Produced a manual on wildlife control methods for airports.
- Installed soft-ground arresting systems to stop aircraft overruns at a major international airport. On May 8, 1999, the arrestor bed installed at John F. Kennedy International Airport, New York, safely stopped a Saab 340 aircraft carrying 27 passengers and 3 crew members, from possibly plunging off the end of the runway into Thurston Bay.
- Developed improved pavement marking for enhancing visibility, durability, and skid resistance.
- Began operations of an aircraft deicing facility using infrared energy at a major hub airport.

- Developed a driver's enhanced vision system for firefighting vehicles to navigate in rain, snow, and fog.
  - Developed an environmentally acceptable replacement for the chlorofluorocarbon (CFC) ozone depletor Halon 1211.
  - Developed specification for a 55-foot elevated boom and aircraft cabin skin-penetration system.
  - Completed a study on stability of heavy rescue vehicle and anti-rollover systems.
  - Completed an evaluation of ramp access to commuter aircraft for people with mobility impairments.
  - Issued new pavement design standards to allow operation of Boeing B-777 without weight penalties.
  - Established a Center of Excellence (COE) in Airport Pavement Research at the University of Illinois and Northwestern University.
  - Installed a comprehensive instrumentation system in concrete pavements at Denver International Airport.
  - Completed construction of the National Airport Pavement Test Facility and dedicated it on April 12, 1999. Testing at the facility started on June 4, 1999.
  - Established an airport pavement data base containing field data collected at Denver International Airport, allowing on-line access to researchers worldwide.
  - Completed data collection for taxiway centerline deviation study at John F. Kennedy International Airport, and began data collection at a second major airport.
- FAA-University of Illinois/Northwestern University (COE for Airport Pavement Research)\*\*
  - FAA-Boeing Company, Cooperative Research and Development Agreement (\$7 million Boeing/\$21 million total for National Airport Pavement Test Machine)\*\*\*
  - FAA-Agencies of Canadian Government (for pavement technology and winter operations safety)\*\*\*
  - FAA-NASA (for joint runway traction research)\*
  - FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed)\*
  - FAA-industry (to test and develop infrared deicing facilities and soft-ground arrestor materials)\*\*\*
- \* Interagency agreement or Memorandum of Agreement (MOA)
  - \*\* Partnership through matching funds
  - \*\*\* Cost Sharing
- Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

**MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:**

*Airport planning and design technology*

- Produced reports providing data for sizing terminal elements such as ticket counters and hold rooms.

*Airport pavement technology*

- Continued 3-dimensional Finite Element Model (FEM) development: computational efficiency, study of effects of slab size and gear configurations.
- Completed documentation report for Layered Elastic Pavement Design Program Package (LEDFAA).

**R&D Partnerships:**

- FAA-U.S. Army Waterways Experiment Station\*
- FAA-U.S. Air Force, Tyndall Air Force Base\*
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio\*

- Refined failure models for 6-wheel and 4-wheel gear configurations based on analysis of data collected from NAPTF.
- Continued data collection and analysis at Denver International Airport (DIA).
- Published report on 3D finite element model field verification using DIA data.
- Published interim report on National Registry of Airport Pavements.
- Investigated airport wildlife control and detection techniques including use of bird effigies, laser, and microwave as wildlife dispersion methods, and evaluation of radar for wildlife detection.
- Continued to develop bird-strike risk assessment factors for civilian airports.
- Set up comprehensive web site on wildlife mitigation methods and techniques, and continued to populate the National Strike Database.

#### *National Dynamic Airport Pavement Tests*

- Completed the first series of full-scale traffic (life) tests at FAA's National Airport Pavement Test Facility (NAPTF).
- Implemented a database of full-scale test results, allowing on-line access to the test data.
- Began analyzing full-scale traffic test data to relate pavement performance to design.
- Reconstructed all pavement test items at the NAPTF and programmed the second series of full-scale traffic tests.
- Continued material testing and evaluation for the NAPTF.

#### *Airport safety technology*

- Continued development means to acquire and report runway surface friction values for pilot use.
- Completed evaluation of Light-Emitting Diode (LED) light strips for movement and non-movement areas.
- Completed evaluation of fiber-optic runway-distance-remaining signs at Pittsburgh International Airport.
- Completed initial development of the full-scale post crash interior fire suppression facility.
- Published testing standards for airport fire-fighting extinguishing agents.
- Completed wildlife habitat study at John F. Kennedy International Airport focusing on grass height and vegetation types.
- Initiated the following studies on wildlife habitats: habitat study in the Pacific Northwest (focusing on vegetation); relocation of raptors at Chicago O'Hare Airport; grass height at USDA Plum Brook Station; habitat study in the southwest.

#### **KEY FY 2002 PRODUCTS AND MILESTONES:**

- Conduct the second series of full-scale traffic tests (life tests) at NAPTF.
- Complete reports on sizing terminal components and compiling information on other aspects of terminal planning.
- Continue to analyze full-scale traffic test data from NAPTF to relate performance to designs.
- Release updated pavement design program package (LEDFAA 2.0).
- Continue development of three-dimensional finite element based pavement design procedures.
- Continue data collection and analysis at Denver International Airport.
- Complete improvement of back-calculation methods for Nondestructive Testing (NDT) of airport pavements.
- Produce report on taxiway centerline deviations of B-747 wide body aircraft at JFK and Anchorage.
- Conduct evaluation of improved airport lighting.
- Publish specifications for aircraft infrared de-icing system.
- Complete full-scale 2nd level interior fire suppression facility (Phase II).
- Conduct full scale 2nd level fire suppression testing.
- Complete research on next generation elevated boom technology.
- Develop specifications for prototype Interior Intervention Vehicle (IIV).

**2001 FAA NATIONAL AVIATION RESEARCH PLAN**

- Initiate research for replacement primary fire extinguishing agent.
- Continue wildlife habitat studies in the Southwest and Pacific Northwest, at Chicago O’Hare Airport, and at USDA Plum Brook Station.
- Continue evaluation of wildlife dispersion techniques.
- Begin development of the National Advisory Wildlife Strike System for Airports.
- Continue populating the National Wildlife Strike Database.

**FY 2002 PROGRAM REQUEST:**

The Airport Technology FY 2002 research program is a collaborative effort among many government organizations, universities, and industry associations. The program funding requested provides the contract support necessary for an integrated, effective research program that delivers the standards and guidelines for maintaining and enhancing airport infrastructure.

**APPROPRIATION SUMMARY**

|   |                       |
|---|-----------------------|
|   | <u>Amount (\$000)</u> |
| Appropriated (FY 1982-2000)             | \$9,200               |
| FY 2001 Enacted                         | 11,400                |
| FY 2002 Request                         | 9,547                 |
| Out-Year Planning Levels (FY 2003-2006) | <u>55,197</u>         |
| Total                                   | \$85,344              |

| Budget Authority (\$000) | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Enacted | FY 2001 Enacted | FY 2002 Request |
|--------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Contracts:               |                 |                 |                 |                 |                 |
| Airport Technology       | 0               | 2,703           | 4,200           | 9,400           | 7,547           |
| Personnel Costs          | 0               | 2,016           | 0               | 1,800           | 1,800           |
| Other In-house Costs     | 0               | 281             | 0               | 200             | 200             |
| <b>Total</b>             | <b>0</b>        | <b>5,000</b>    | <b>4,200</b>    | <b>11,400</b>   | <b>9,547</b>    |

| OMB Circular A-11, Conduct of Research and Development (\$000) | FY 1998 Enacted | FY 1999 Enacted | FY 2000 Enacted | FY 2001 Enacted | FY 2002 Request |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|
| Basic  | 0               | 0               | 0               | 0               | 0               |
| Applied  | 0               | 0               | 0               | 0               | 0               |
| Development (includes prototypes)                              | 0               | 5,000           | 4,200           | 11,400          | 9,547           |
| <b>Total</b>   | <b>0</b>        | <b>5,000</b>    | <b>4,200</b>    | <b>11,400</b>   | <b>9,547</b>    |

**Notes:**

- Airport Technology FY 2002 funding request is included in the AIP Appropriation.
- Current year and all out years request includes in-house costs. Out year funding request is under review.

| Airport Technology<br>Product and Activities  | FY 2002<br>Request<br>(\$000) | Program Schedule |                |                 |                 |                 |                 |
|---|-------------------------------|------------------|----------------|-----------------|-----------------|-----------------|-----------------|
|   |                               | FY 2001          | FY 2002        | FY 2003         | FY 2004         | FY 2005         | FY2006          |
| <i>Airport Technology</i>   | \$7,547                       |                  |                |                 |                 |                 |                 |
| Conduct the Second Series of Full-Scale Traffic Tests (Life Tests)  | ◆                             | ◇                |                |                 |                 |                 |                 |
| Continue to Analyze Full-Scale Traffic Test Data from NAPTF to Relate Performance to Designs                    | ◆                             | ◇                |                |                 |                 |                 |                 |
| Release Updated Pavement Design Program Package   |                               |                  |                |                 |                 |                 |                 |
| Continue Development of Three-Dimensional Finite Element Based Pavement Design Procedures                       | ◆                             | ◇                | ◇              | ◇               | ◇               | ◇               |                 |
| Continue Data Collection and Analysis at Denver International Airport   | ◆                             | ◇                | ◇              | ◇               | ◇               | ◇               |                 |
| Complete Improvement of Back-Calculation Methods for Non-Destructive Testing of Airport Pavements               |                               |                  |                |                 |                 |                 |                 |
| Produce Report on Taxiway Centerline Deviations of B-747 Wide Body Aircraft                                     | ◆                             | ◇                | ◇              | ◇               |                 |                 |                 |
| Conduct Evaluation of Improved Airport Lighting   | ◆                             |                  | ◇              | ◇               | ◇               | ◇               | ◇               |
| Publish Specifications for Aircraft Infrared Deicing System   | ◆                             |                  | ◇              | ◇               | ◇               | ◇               |                 |
| Develop Standards for Anti-Rollover and Stability Requirements for Heavy Airport Rescue Vehicles                | ◆                             | ◇                |                | ◇               | ◇               | ◇               | ◇               |
| Develop Full-Scale Interior Fire Suppression Facility to Perform Next Generation Aircraft Requirements Research | ◆                             |                  | ◇              |                 |                 |                 | ◇               |
| Publish Testing Standards for Airport for Fire Fighting Extinguishing Agents                                    | ◆                             | ◇                |                | ◇               |                 |                 | ◇               |
| Continue Populating the National Strike Data Base   | ◆                             |                  | ◇              |                 |                 |                 |                 |
| Perform Wildlife Habitat Modeling at Selected Airports  | ◆                             | ◇                |                | ◇               |                 |                 | ◇               |
| <b>Total Budget Authority</b>   | <b>\$7,547</b>                | <b>\$9,400</b>   | <b>\$7,547</b> | <b>\$16,270</b> | <b>\$15,762</b> | <b>\$11,890</b> | <b>\$11,275</b> |

**Note:**

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- Current year and all out years request includes in-house costs. Out year funding request is under review.

