Introduction

The Federal Aviation Administration is sponsoring a national Design Competition for Universities that engages university students in addressing issues relating to airports. The Competition challenges individuals and teams of undergraduate and/or graduate students, working with faculty advisors, to consider innovative approaches to related Design Challenges. Design Challenges focus on ways to improve the management, safety, capacity and efficiency of the nation’s airports. This is the sixth year of the Competition.

Competition Goals are to:

1. Raise awareness of the importance of airports to the National Airspace System infrastructure.
2. Increase the involvement of the academic community in addressing airport operations and infrastructure issues and needs.
3. Engage students at U.S. colleges and universities in the conceptualization of applications, systems and equipment capable of addressing related challenges in a robust, reliable and comprehensive manner.
4. Encourage undergraduate and graduate students at U.S. colleges and universities to contribute innovative ideas and solutions to airport and runway safety issues.
5. Provide a framework and incentives for quality educational experiences for university students.
6. Develop an awareness of and an interest in airports as a vital and interesting area for engineering and technology careers.

The Competition website is the participant’s source for complete and up-to-date information on the Competition.

The website contains:

- Competition Guidelines
- FAA Reports and Resources
- Online Design Submission Process
- Expert Advisors
- On-line Notice of Intent Electronic Submission Form
- Winning Designs from the 2007-2011 Competition
- Contact Information for Queries

Competition updates will be posted on the website.
About The FAA

The Federal Aviation Administration (FAA) is part of the Department of Transportation and is responsible for the safety of civil aviation. The activities of the FAA include:

- Regulating civil aviation, including commercial service airports, to promote safety;
- Encouraging and developing civil aeronautics, including new aviation technology;
- Developing and operating a system of air traffic control and navigation for both civil and military aircraft;
- Researching and developing the National Airspace System and civil aeronautics;
- Developing and carrying out programs to control aircraft noise and other environmental effects of civil aviation; and
- Regulating U.S. commercial space transportation.

The FAA provides the framework for a safe, secure, and efficient aviation system. As a leading authority in the international aviation community, the Agency is responsive to the dynamic nature of customer needs, economic conditions, and environmental concerns.

The FAA encourages and supports innovative, advanced research of potential benefit to the long-term growth of civil aviation and commercial space transportation. The pursuit of basic and applied research in scientific and engineering disciplines that have the potential to further knowledge and understanding on a broad front of emerging technologies is crucial to the realization of this goal. The intent is to encourage applied research and development to enhance technology assimilation, transfer, development and application to FAA problems, needs and goals.

For the purposes of this Competition, the FAA is focusing on the following areas: Airport Operations and Maintenance; Runway Safety/Runway Incursions; Airport Environmental Interactions; and Airport Management and Planning through challenges defined in the Technical Design Challenges section below.

New challenges added this year are highlighted in red.

Competition Partners

The FAA gratefully acknowledges the contributions of the following partnering organizations that supply expert advisors for teams, assist in dissemination of the Competition opportunity to organizational members, and participate in design reviews.

The American Association of Airport Executives (AAAE)
AAAE is the largest professional organization for airport executives in the world, representing thousands of airport management personnel at public use airports nationwide. The organization's primary goal is to assist airport executives in fulfilling their responsibilities to the airports and communities they serve.

The Airport Consultants Council (ACC) ACC is an international trade association representing more than 240 companies that provide development and operations related consulting and product services to airports and other aviation system stakeholders. Members offer architectural, engineering, planning, security, environmental, financial, management, economic and construction services, products and equipment.

The Airports Council International - North America (ACI-NA) ACI-NA is a membership organization representing approximately 160 state, regional, and local governing bodies that own and operate the principal airports served by scheduled air carriers in the United States and Canada. ACI-NA member airports handle approximately 98 percent of the domestic and virtually all of the international air passenger traffic and cargo traffic in North America.

The National Association of State Aviation Officials (NASAO) NASAO was founded to ensure uniformity of safety measures, to standardize airport regulations and develop a truly national air transportation system responsive to local, state, and regional needs. The
organization represents the men and women in state
government aviation agencies who serve the public
interest in all 50 states, Guam, and Puerto Rico.

**University Aviation Association (UAA)** UAA is the
voice of collegiate aviation education to its members, the
industry, government and the general public. Through
the collective expertise of its members, this nonprofit
organization plays a pivotal role in the advancement
of degree-granting aviation programs that represent all
segments of the aviation industry.

The Competition is managed for the FAA by the Virginia
Space Grant Consortium based in Hampton, Va (http://
www.vsgc.odu.edu).

**Overall Requirements**

The FAA Design Competition for
Universities is open to teams or
individuals from accredited U.S.
colleges and universities who are
working with a faculty advisor. The
Competition will be open for student
participation from August 31, 2011
through April 27, 2012, allowing
participation during fall semester
2011 and/or spring semester 2012.
Final due date for all submittals is
April 27, 2012 and all submissions
will be judged after the due date.
Challenges might typically be
addressed as part of a senior design
class or independent study option
or through other academic venues,
including faculty-mentored, college-based student
chapters of professional societies. **The Competition
requires evidence of interaction with airport
operators and industry experts for feedback on the
practicality of the proposed design/approach.**

Participants are encouraged to take an interdisciplinary
approach to the selected topic and a cross-departmental
approach where appropriate. Design submissions
must be student written and demonstrate a thorough
understanding of current conditions/state of the art
approaches relevant to the chosen topic. Guidelines for
elements of the design package are provided below.

Note that additional information, resources, and
responses to queries will be posted on the Competition
Scoring criteria for design review will also be posted on
the Competition website. The Design packages will be
submitted, in part, electronically with instructions and
necessary forms provided on the website.

**Notice of Intent:** Though not required, participants
are strongly encouraged to provide a nonbinding Notice
of Intent, which is submitted electronically through
the Competition website. The purpose of the Notice
of Intent is to allow the FAA to assist as needed with
providing access to Airport Operators and expert sources
that can be of help to the student or student team in
the design process. FAA personnel and members of
partnering organizations will serve as resources to design
teams or individual participants. A key goal of the
Competition is to enhance the educational experience of
the students. The FAA believes that by providing access
to experts, the educational process can be strengthened;
students gain exposure to professionals in the field; and
students will be better able to assess the practicality of
their designs. The Notice of Intent will also assist the
Agency with planning for the review process to include
appropriate subject matter experts.

Once a Notice of Intent is received, the faculty advisor
will be contacted to see what assistance might be needed.
For maximum effectiveness, the Notices of Intent should
be submitted in advance of beginning the design process
and by September 30, 2011 for projects commencing
with the fall semester and January 31, 2012 for projects
commencing the spring semester. A Notice of Intent
will be accepted later; however, teams are encouraged to
submit by the suggested date.
Technical Design Challenges

I. Airport Operation and Maintenance

The day-to-day operation and maintenance of an airport involves many tasks. Airport operators must handle both routine matters and unusual circumstances. Their responsibilities include keeping records; hiring and training personnel; maintaining pavement; maintaining markings, signs, and lighting; providing snow and ice control, if applicable; managing emergency preparedness; overseeing handling of hazardous materials, including jet fuel; conducting airport self-inspections; overseeing procedures for operation of vehicles on the airfield; providing obstruction lighting; protecting navigational aids; protecting public safety; dealing with wildlife control; and overseeing construction projects.

There are almost 20,000 airports in the United States today. Of those, approximately 8,700 have paved runways, taxiways and ramps/aprons. Paved airport surfaces can be affected by many things: adverse weather, build-up of rubber residue from aircraft tires, and normal wear and tear. The pavement surface must also be kept free of what is referred to as foreign debris. This debris can be in the form of such things as rocks and stones tracked onto the pavement from grass areas adjacent to the pavement, material coming off aircraft during taxiing, landing, or takeoff, and objects blown from the aircraft servicing areas onto the pavement surfaces. This debris can cause major damage to aircraft engines if it is ingested or affect the aerodynamics of a propeller.

Airport operators certificated under 14 Code of Federal Regulations Part 139 are required to keep these surfaces in a condition that meets requirements specified in the regulation. These surfaces are inspected visually on a regular basis so any deficiencies can be found and corrected. Some automated systems have been developed to supplement some aspects of these visual inspections.

Naturally, in the interest of safety, an airport surface must be closed for a pavement repair. Runway closures reduce capacity at that airport, affecting carriers that may have to juggle flights to accommodate the repair and inconveniencing non-airline (called general aviation, or simply GA) aircraft that need to use alternate airfields, especially if the closure is unplanned. Any technologies or procedures that either improve the structure/longevity of pavement, increase the speed of repairing pavement, or automatically alert the airport operator to hazardous pavement conditions will be a welcome advance for airports.

This Design Category has challenges that focus on design and maintenance of pavement surfaces that will help airport operators increase airfield efficiency outside of the terminal and airport buildings.

Airport Operation and Maintenance Challenges:

A. Exploring new methods for design and maintenance of pavement surfaces. Ideas include, but are not limited to:
   - Methods for innovative pavement repair.
   - Innovative pavement materials, installation and maintenance techniques, including non-destructive evaluation methodologies.
   - Improved approaches to rubber removal/surface restoration due to aircraft tire friction.
   - New or improved techniques for ice removal from runways.

B. Improved methods for foreign object detection and removal from runway surfaces.

C. Innovative approaches to address wildlife issues at airports including bird strikes.

D. Improved tug systems for aircraft.

E. Innovative applications, including web-based solutions, for airport operations and maintenance.

While students will need to undertake a thorough literature search, some key documents to begin the process are listed on the Competition website.

II. Runway Safety/Runway Incursions/Runway Excursions

The United States National Airspace System (NAS) has nearly 500 FAA.contract towered airports that handle
more than 171,000 aircraft operations – takeoffs and landings – a day, averaging approximately 60 million airport operations per year. A runway incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft. Of the approximately 290 million takeoffs and landings at United States towered airports from FY 2006 through FY 2010, there were 4,522 reported runway incursions.

This performance record means that there were approximately 15 runway incursions for every one million operations and less than one serious runway incursion for every one million operations. Four of the 4,522 incursions resulted in collisions on the runway. Although no fatalities occurred from these collisions, collisions in prior years did involve fatalities. The worst collision in civil aviation history as measured by fatalities (583) was a runway incursion that occurred at Tenerife in the Canary Islands.

One of the FAA’s top priorities is to reduce the frequency of runway incursions and the risk of a runway collision. The FAA aims to reduce the severity, number, and rate of runway incursions by implementing a combination of technology, infrastructure, procedural and training interventions to decrease the prevalence of human errors and increase the error tolerance of airport surface movement operations. The FAA is developing airport design concepts and surface movement procedures, such as the use of perimeter taxiways, to decrease the number of runway crossings and thereby reduce the risk of runway incursions. Related efforts address the errors committed by pilots, air traffic controllers, and airport-authorized vehicle operators and pedestrians.

Also of great concern are runway excursions. A runway excursion occurs when an aircraft departs the runway in use during the take-off or landing run or during taxiing. The excursion may be intentional or unintentional. Runway excursions are mainly of three types – overrun, undershoot and veer-off. Examples of runway excursions include: 1) a landing aircraft is unable to stop before the end of the designated runway is reached leading to an overrun; 2) an aircraft taking off or rejecting takeoff or landing departs the side of the designated runway leading to a veer-off; 3) an aircraft attempting a landing touches down in the undershoot area of the designated landing runway within the aerodrome perimeter; or 4) a runway or taxiway other than the designated one is used for a takeoff or a landing.

Runway excursions are the most frequent accident category worldwide with an average of 42 such accidents annually (1998 – 2007). During the same time, 71% of the world’s jet aircraft accidents are attributed to runway excursions, claiming 41% of all on board and third party fatalities. There has been no significant reduction in the runway excursion accident rate in over twenty years, and recent studies of runway excursions have called for appropriate measures to be taken to address this problem. 

**Runway Safety/Runway Incursions/Runway Excursions Challenges:**

A. Expanding situational awareness of pilots and ground operators on the airfield. Ideas include, but are not limited to:
   - Direct warning systems to alert pilots that they are approaching a runway and if the runway is occupied.
   - Direct warning systems to alert air traffic controllers for situations leading to runway incursion.
   - Direct warning systems to alert airfield drivers that they are approaching a runway they are not authorized to cross.
   - Development of innovative techniques to record, analyze and display annotated spatial data for improved situational awareness of ground operations.
   - Methods for aircraft/runway interface that address issues caused by new energy efficient lighting not being visible to heat sensing, enhanced flight vision systems.

B. Enhancing Airport Visual Aids
   - Improved lighting, marking, and signage for runways, taxiways and the airport apron.
   - Lighting other than traditional incandescent.
   - Providing surface navigation guidance to pilots in the cockpit via electronic alternatives in limited visibility conditions (in lieu of outside visual cues).

C. Runway Excursions
   - Identification of major causal/contributory/contextual factors leading to runway excursions.
   - Risk analysis of runway excursions due to overrun/undershoot/veer-offs.
   - Innovative approaches to reducing runway excursions and associated risks.

While students will need to undertake a thorough literature search, a few key documents to begin the process are listed on the Competition website.
III. Airport Environmental Interactions

As the FAA carries out its mission, it must comply with regulations protecting the environment. All airport operations must be carried out with consideration for how the environment could be adversely affected. Airport environmental concerns may include many things: noise; land use; social impacts; air quality; endangered and threatened species; energy supply and natural resources; light emissions; solid waste impacts; or construction impacts. For the purpose of this Competition, the FAA has chosen to focus on: making snow and ice removal more environmentally friendly, improved methods for containment and cleanup of fuel spills, and energy efficiency.

As mentioned in Section I, Airport Operations and Maintenance, one of the airport operator’s responsibilities is snow and ice control on paved surfaces. Air carriers/pilots must ensure their aircraft are free of ice/snow to enable a safe takeoff. In many cases, this involves application of a chemical agent, which for both aircraft and airport pavements must meet strict corrosivity requirements. After the aircraft is treated, the airport operator is left with the problem of how to dispose of these chemicals or other clean-up required. Any improvements in aircraft and/or pavement anti-icing and/or de-icing agents themselves, new methodologies or procedural improvement would be welcome.

Another environmental hazard is fuel spills. While a hazard on the airfield itself, airport operators must also ensure the spilled fuel does not enter the water supply where it can do even more damage. Storm water management at airports is important to prevent contaminants such as chemicals and fuels from entering the water table.

Energy efficiency is another factor of environmental responsibility at airports. Energy is required for all airfield buildings, vehicles, and the airfield itself. It can be a challenge, especially at remote airports that may not have an independent power source, to keep the airfield properly lit.

This Design category has challenges that focus on improvements in snow and ice removal, containment and clean up of fuel spills, storm water management and energy efficiency, that will help the FAA carry out its mission in a way that will be environmentally sound.

Airport Environmental Interactions Challenges:

A. Making snow and ice removal more environmentally friendly. Both chemical and nonchemical options can be considered. The FAA is seeking designs that offer:

- Improved means and methods of complying with aircraft and airfield anti- and de-icing requirements.
- Environmentally safe aircraft and airfield anti- and de-icing products that are compatible with both aircraft structures and airport pavements.
- Improved containment and cleanup of anti- and de-icing products.

B. Improving methods for containment and cleanup of fuel spills:

- Bioremediation techniques for fuel spill cleanup.
- Techniques/substances for neutralization of toxic components of fuel.
- Techniques/substances that delay the biological and chemical breakdown of fuel, allowing cleanup to occur without causing rapid decreases in dissolved oxygen in receiving waters that result from biological and chemical degrading of the fuel.
- Techniques for prevention of percolation of fuel into ground water.

C. Increasing energy efficiency in the management of airfields. (This challenge specifically excludes consideration of terminal and other airport buildings.) Topics that might be considered include:

- Alternative energy/energy efficient airport equipment such as tow vehicles, emergency generators, power units, heating systems, etc. for use in airfield areas.
- Alternate energy sources and approaches to providing lighting at remote airports that don’t have access to electrical power.
- Innovative approaches to solid waste reduction at airports.

D. Innovative methods for stormwater management at airports.

E. New tools and approaches to noise reduction at airports.

While students will need to undertake a thorough literature search, some key documents to begin the process are listed on the Competition website.

IV. Management and Planning

In today’s airport environment, especially at the busier airports, any change in “normal” operations affects that particular airport, and also may ripple across the NAS and affect many other airports and passengers. To meet this challenge, the FAA, airport operators, and
airport users must work together to develop action plans that provide the best solutions for local and regional areas, as well as the nation. An integrated approach is preferred which includes improving technology, air traffic control procedures, and expanding airport and airfield infrastructure.

Airport Management and Planning Challenges:

This Design Category has challenges that focus on airfield management and planning that will help airport operators optimize the use of existing airport resources and plan for upcoming functional needs.

A. Maximizing Airport Capability

• Strategies for accommodating aircraft that experience extended delays on the tarmac and in line for take off, including dealing with human needs as well as airport and airline capabilities.
• Innovative approaches to demand forecasting and management for airports.
• Innovative strategies for reducing airline fuel consumption, such as new ways to reduce gate-to-gate time or revise procedures.
• Effective alternatives to current ramp and gate controls.
• Creative approaches to airport revenue generation for general aviation airports.

• Models for collaborative decision making and data sharing at airports.

While students will need to undertake a thorough literature search, a few key sources to begin the process are listed on the Competition website.

Guidelines for Design Submission

It is strongly recommended that participants review the Tips for Proposers section of the Competition website. Each of the following should be identified as a separate section of the design.

Design Package Components:

1. Main Body of the Design Submission

The main body of the report must contain the following sections. There is a limit of 40 pages. See format on page 8.

• Cover page to include: Title of Design; team member(s) names and status (undergraduates or graduates); advisor(s) names and university attending.
• Executive Summary – 1 page.

• Table of contents with page numbers referenced for each section and appendix.
• Problem Statement and Background on the Design Challenge being addressed. This section should demonstrate that the individual or team has a clear understanding of the issues surrounding the design challenge as well as current conditions and state-of-the-art approaches.
• Summary of Literature Review. This is an overview of what was gleaned from the literature with a discussion of primary sources and their influence on the design. Specific reference citations are to be provided in Appendix F.
• Individual or Team’s Problem Solving Approach to the Design Challenge. This section should include a thorough description of individual’s or team’s work including a description of both interdisciplinary and systems engineering approaches as appropriate to solving the problem.
• Safety Risk Assessment: The FAA promotes a culture of safety throughout all its operations. Examine existing FAA safety management system guidance as it relates to your proposed design solution. Consider inherent risks and describe how these risks should be addressed to ensure safe operations. Be sure to reference Introduction to Safety Management Systems for Airport Operators (FAA Advisory Circular 150/5200-37) and FAA Safety Management System Manual available under the Resources section of the Competition website.
• Description of how the technical aspects of the Design Challenge are addressed through drawings, mockups, computer codes, etc. as appropriate to provide evidence of a thorough design process.
• Description of interactions with airport operators and industry experts in the design process. Be explicit. Identify contacts and interactions. This is a required Competition component.
• Description of the projected impacts of the team’s design and findings with a thorough discussion of how the design/solution meets FAA goals. This section should address commercial potential for the design, including a description of processes that would need to be undertaken to bring the design to the product/implementation state. Emphasis should be on increased affordability and utility. The section should provide a financial analysis that reflects a realistic approach to projected cost/benefit determination and for the team’s design.
2. Appendices A-F as described below are required but not included in the 40-page limit.

- **Appendix A.** List of complete contact information (use permanent addresses) for all advisors and team members. Include email, fax and phone numbers. This information is crucial as student participants may have graduated prior to receiving an award and all award checks are mailed directly to the participants.

- **Appendix B.** Description (approximately one page) of the university or college.

- **Appendix C.** Description of non-university partners involved in the project.

- **Appendix D.** Sign-off form for faculty advisor(s) and department chair(s). Signoff form is available at the Competition website.

- **Appendix E.** Evaluation of the educational experience provided by the project. Evaluation questions for both student and faculty are provided on the Competition website.


**Format:** Double-spaced, single-sided, minimum 12-point type, Times New Roman or Helvetica font. Captions and charts may be at a minimum of 10-point type. Pages, including appendices, must be numbered and referenced in Table of Contents.

**Due Date:** The design package will be submitted electronically following guidelines provided at the Competition website. In addition, one hard copy of the full design plus the original of the Sign-off form must be mailed to the Virginia Space Grant Consortium, 600 Butler Farm Road, Suite 2253, Hampton, VA 23666. All electronic and hard copy submissions must meet the 5 p.m. (Eastern Daylight Time) deadline on April 27, 2012. It is strongly recommended that a mail service that certifies delivery be used. The faculty advisor will receive a submission acknowledgement via email.

By submission of the design package, Competition participants are agreeing that their design may be publicly shared.

**Awards:**
A cash award will be given to the student or student team members in each category as follows:

- **Airport Operation and Maintenance Design Award:** First place - $2500; Second Place - $1500, Third Place - $1000.

- **Runway Safety/Runway Incursions/Runway Excursions Design Award:** First place - $2500; Second Place - $1500, Third Place - $1000.

- **Environmental Interactions Design Award:** First place - $2500; Second Place - $1500, Third Place - $1000.

- **Airport Management and Planning Design Award:** First place - $2500; Second Place - $1500, Third Place - $1000.

First place award-winning team representatives will be invited to accept their award and present their design at the FAA/TSA/ACC Summer Workshop Series in Arlington, Virginia, July 18-19, 2012. A travel allowance of up to $2500 per award will be provided for at least two individuals (two students or one faculty advisor and one student) from each first place winning team.

**Key Dates:**

**Competition Announcement – August 2011**

Notice of Intent (NOI) is strongly encouraged. Fall semester NOI deadline is September 30, 2011. Spring semester NOI deadline is January 31, 2012. See page 3 for details.

Design submissions accepted from November 1, 2011 through April 27, 2012. Design submittal deadline is 5 p.m. (Eastern Daylight Time), April 27, 2012.

Note: students may work on their designs at any time throughout the Competition period.

Winners will be announced by June 8, 2012.

Award Ceremony and Presentations by first place winners will be held at the FAA/TSA/ACC Summer Workshop Series in Arlington, Virginia, July 18-19, 2012.

Contact information for questions regarding the Competition is provided at the Competition website. At the FAA’s discretion, queries and responses may be made available to all design teams via the Competition website.

[http://FAADesignCompetition.odu.edu](http://FAADesignCompetition.odu.edu)