Commercial Space Transportation (AST)

Commercial Space Transportation RE&D Program

To: REDAC NAS Ops Subcommittee

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   Director Commercial Space Integration
   FAA Office of Commercial Space Transportation

Date: March 9, 2016
Agenda

• Overview
  – State of the Commercial Space Industry
  – Emerging Challenges

• Commercial Space Transportation RE&D
  – New Budget Line for FY16 & beyond

• Summary & Discussion
Expanding Commercial Capabilities

Industry Responding to Growing Market Demand

Virgin Galactic “SpaceShipTwo”
Virgin Galactic “LauncherOne”
Boeing

Blue Origin
Orbital Sciences
Space X

Sierra Nevada Corp

XCOR Aerospace
Firefly
Rocket Lab

Office of Commercial Space Transportation
AST Responsibilities, Products & Services

• Licensing
  – Launch and reentry vehicle operations
  – Launch and reentry site operations

• Experimental Permits
  – Suborbital Reusable Launch Vehicle (RLV) operations

• Safety Approvals
  – Systems, subsystems, and processes

• Safety Inspections & Oversight
  – Inspections and compliance monitoring for AST-issued licenses and permits
  – Mishap response & oversight

• Environmental Review (NEPA compliance)

• Liability Determination (e.g., “Maximum Probable Loss”)

• Rulemaking
  – Development and publication of regulations, guidelines, and Advisory Circulars

• Infrastructure Development
  – Spaceport (STIM) Grants (prior years)
  – Air-Space integration/coordination
  – Government partnerships

• Research
Increasing Complexity Highlights a Number of R&D Challenges

Blue Origin PM 2 (11/23/2015)

Concept

SpaceX ORBCOMM-2 (12/21/2015)
Illustration: Aircraft Hazard Areas (AHAs) Protect Aircraft from the Consequences of Launch

Example of Calculated Risk Contours

Airspace Planning & Prioritization

Gap may allow increased airspace efficiency during launch

Aircraft kept out of AHA for 25 minutes
PPT Portfolio Overview

- The Commercial Space Transportation RE&D portfolio will enable advances in critical areas such as:
  - Safe and efficient integration of increased commercial space launch and reentry activity into the national airspace
  - Advanced safety assessment methods
  - Advanced vehicle safety technologies and methodologies, and
  - Human space flight safety and physiology factors

- Funding enables maturation of concepts for follow-on use in methods, systems, operations and the regulatory framework

- Funding also sustains cooperative, innovative R&D within the FAA’s Commercial Space COE
NARP BLI Milestone Summary

- FY2016 President’s request included Commercial Space Transportation Safety RE&D budget line for the first time
  - Appropriation $2M vs $3M requested
  - Funding will be split: $1M new applied program, $1M Center of Excellence
- Detailed planning for specific FY16 milestones and beyond continues based on appropriations uncertainty
- Funding profile:

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<th>FY16 Approp</th>
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<td>Funding Target ($000)</td>
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NARP BLI Milestone Development

- **Research projects within *Safe and Efficient Integration* may include:**
  - Improving integration of launch sites (i.e., spaceports) into the NAS and its system of airports, including sites in the vicinity of major airports or complex airspace.
  - Exploring the development of separation standards for improved airspace management of launch/reentry vehicles during non-explosive phases of flight.
  - Improving airspace integration planning for return to land-based sites to decrease the amount of airspace closed to air traffic operations by using higher fidelity input data and models.
  - Improving real-time monitoring of launch/reentry vehicle operations for airspace integration, to decrease the amount of airspace closed to regular air traffic operations and expedite response to off-nominal scenarios.
  - Developing and validating improved noise models for commercial space launch operations at inland launch sites, including spaceports co-located with airports.
  - Improving methods for launch and reentry collision avoidance analysis to produce more efficient launch and reentry planning and NAS integration.
NARP BLI Milestone Development

- Research projects within *Advanced Safety Assessment Methods* may include:
  - Exploring advanced commercial space flight data sharing and mining capabilities to inform safety assessments and identify emerging safety issues.
  - Improved methods to evaluate failure probabilities for launch and reentry vehicles.
  - Advanced study and model development of break-up characteristics of space vehicles, such as hybrids or other new concepts currently under consideration.
  - Improved safety analysis methods to assess and manage hazards to dynamic population clusters, such as for the public on roads and rail.
  - Improved understanding of aircraft vulnerability to space-vehicle-breakup debris, including model development and refinement to reduce over-conservatism applied to airspace “keep out” areas used to protect against a launch or reentry vehicle failure.
NARP BLI Milestone Development

• Research projects within *Advanced Vehicle Safety Technologies* may include:
  – Improved understanding of emerging autonomous flight safety systems and exploring mitigation factors to address their potential vulnerabilities.
  – Exploring the repetitive use considerations for high utilization reusable space vehicles, to include assessing the use of integrated vehicle health monitoring technologies and reentry breakup recorders when applicable.
NARP BLI Milestone Development

• Research projects within *Human Spaceflight and Physiological Safety Factors* may include:
  
  – *Improved crew safety systems* for proposed space flight vehicles, including *systems to monitor the cabin environment and support safety actions* in the event of contingencies.
  
  – *Voluntary physiological data collection from both human spaceflight participants and crew*, including those participants who may possess common disease states (such as high blood pressure, diabetes, lower back injury, respiratory disease, etc.), to identify potential areas of concern and additional focus.
  
  – *Identifying best practice considerations for crew human factors* for small winged commercial spaceflight vehicles.
Summary

• US Commercial Space Transportation industry is dynamic and growing
  – Increased demand for services, operational tempo
  – Increased complexity and innovation drive critical research needs

• FAA initiated a new Commercial Space Transportation Safety RE&D BLI in the FY2016 Presidents Budget Request

• A robust Commercial Space Transportation RE&D program will allow the FAA to keep pace
  – Continued public safety
    • Improved analysis methods and evaluation of applications
    • Responsive and effective regulatory and policy framework
  – Safe and efficient integration of operations
  – Continued industry innovation and safety improvement
Enabling Enhanced R&D Portfolio to Impact High Priority Areas

“Incubator”

COE (Grants)

Maturation & Development

“Applied” RE&D (Contracts)

Deployment & Use

Regulatory

Methods (e.g., Safety Analysis, MPL)

Systems

Operations

RE&D Funding

Capital & Ops Funding (FAA)

FAA & Industry Use
“Like launching a pencil over the Empire State Building, having it reverse, come back down and land on a shoebox on the ground – in a windstorm”