

OFFICE OF COMMERCIAL SPACE
TRANSPORTATION'S FISCAL YEAR
2012 BUDGET REQUEST

HEARING
BEFORE THE
SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE, SPACE, AND
TECHNOLOGY
HOUSE OF REPRESENTATIVES
ONE HUNDRED TWELFTH CONGRESS
FIRST SESSION

THURSDAY, MAY 5, 2011

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**OFFICE OF COMMERCIAL SPACE
TRANSPORTATION'S
FISCAL YEAR 2012 BUDGET REQUEST**

THURSDAY, MAY 5, 2011

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE AND AERONAUTICS,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:00 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Steven Palazzo [Chairman of the Subcommittee] presiding.

RALPH M. HALL, TEXAS
CHAIRMAN

EDDIE BERNICE JOHNSON, TEXAS
RANKING MEMBER

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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May 5, 2011

Subcommittee on Space, and Aeronautics

Hearing on – Office on Commercial Space Transportation's Fiscal Year 2012 Budget Request

10:00 A.M. – 12:00 P.M.

2318 Rayburn House Office Building

Dr. George C. Nield: Associate Administrator for Commercial Space Transportation,
Federal Aviation Administration

Dr. Gerald Dillingham: Director, Physical Infrastructure,
US Government Accountability Office

Dr. Henry R. Hertzfeld: Research Professor of Space Policy and International Affairs,
Elliott School of International Affairs, George Washington University

HEARING CHARTER

**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON SPACE AND AERONAUTICS
U.S. HOUSE OF REPRESENTATIVES**

**Office of Commercial Space Transportation's
Fiscal Year 2012 Budget Request**

THURSDAY, MAY 5, 2011
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

The purpose of the May 5 hearing held by the Subcommittee on Space and Aeronautics is to review the Fiscal Year 2012 budget request submitted by the FAA Office of Commercial Space Transportation (in FAA shorthand the office is referred to as 'AST') and to examine new initiatives in the request to expand the office's roles and responsibilities. AST's FY2012 budget request seeks \$26.625 million, a 74% increase over the FY2010 enacted level (\$15.237 million) and a near-doubling of its workforce, asserting that NASA-sponsored commercial cargo flights to the International Space Station, plus the expected start-up of commercial human sub-orbital flights, places new regulatory demands on their operations.

Witnesses

- **Dr. George C. Nield**, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration
- **Dr. Gerald Dillingham**, Director, Physical Infrastructure, U.S. Government Accountability Office
- **Dr. Henry R. Hertzfeld**, Research Professor of Space Policy and International Affairs, Elliott School of International Affairs, George Washington University

Background

The Office of Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launches and reentries, as well as the operation of non-federal launch and reentry sites. Its mission statement is: "To ensure the protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch and reentry activities, and to encourage, facilitate, and promote U.S. commercial space transportation." AST issued its first launch license in 1989 and since then has licensed 204 launches with no fatalities, serious injuries, or significant damage to the uninvolved public.

In 1984 President Reagan signed an executive order designating the Department of Transportation as the lead federal agency for encouraging and facilitating commercial launch activities within the private sector. Eight months later Congress passed the Commercial Space Launch Act (P.L. 98- 575) which gave legislative authority to DOT's role as the principal oversight agency for the regulation and licensing of commercial space transportation systems. Subsequently, DOT shifted the office to the FAA.

Congress last acted on legislation dealing with commercial space transportation in the 108th Congress. Two bills were enacted: (1) "The Commercial Space Launch Amendments Act", H.R. 5382 (PL 108-492) was introduced by Rep. Dana Rohrabacher and expanded AST's authority to regulate commercial human space flight; (2) H.R. 2608 (PL 108-360) reauthorized the Office of Commercial Space Transportation through FY 2009. No subsequent bill addressing AST has since been enacted.

Licensing Activities

There are three types of launches—national security, civil, and commercial. The Office of Commercial Space Transportation regulates commercial launches; launches of NASA and DOD payloads do not require licenses. In 2010, AST licensed four commercial orbital launches compared to five licensed launches in 2009. For 2011 AST

forecasts four commercial launches will be licensed. No suborbital flights were conducted under FAA experimental permits in 2010.

In 2010 one reentry was conducted under an FAA reentry license. The SpaceX Dragon Capsule successfully reentered the atmosphere and landed in the Pacific Ocean following its first NASA Commercial Orbital Transportation System (COTS) demonstration flight. It was the first reentry license ever granted by FAA. SpaceX anticipates flying its second COTS demonstration flight later this year and Orbital also plans to fly its first COTS demonstration before the end of 2011.

In addition to licensing launches, AST also licenses the operation of commercial launch sites (or “spaceports”). Currently, there are eight—

- Spaceport Florida, Cape Canaveral Air Force Station, FL
- Mid-Atlantic Regional Spaceport, Wallops Island, VA
- California Spaceport, Vandenberg Air Force Base, CA
- Kodiak Launch Complex, Kodiak Island, AK
- Mojave Air & Space Port, CA
- Cecil Field Spaceport, Jacksonville, FL
- Oklahoma Spaceport, Burns Flat, OK
- Spaceport America, Las Cruces, NM

FY2012 Budget Request

FAA Office of Commercial Space Transportation (AST)

FY2010 Enacted	FY2011 Req	FY2012 Req	FY12 vs. FY10 Enacted \$\$\$	FY12 vs. FY10 Enacted %
\$15,237,000	\$15,747,000	\$26,625,000	\$11,388,000	75%

AST’s FY12 budget request seeks \$26.625 million, a 75% increase over FY10 enacted, and compared to the FY11 request it represents a 69% increase (\$10.878 million). Three new proposals are responsible for the spending growth—

- (1) proposed establishment of the “FAA Commercial Spaceflight Technical Center” to be located at the Kennedy Space Center in Florida (\$5 million in FY12 to hire 50 additional employees);
- (2) creation of a “Space Incentives Program” (\$5 million in FY12) ; and
- (3) hiring an additional seven employees (\$1.25 million) for development and implementation of safety requirements and human factors to support development of commercial crew transportation systems and missions.

The budget request includes the following justification: “A key challenge that we are facing today involves the beginning of a new era in commercial human spaceflight: suborbital human spaceflight (space tourism) and orbital crew transportation to the International Space Station. The publication of the new National Space Policy signals an even greater role for the commercial space industry in America’s overall space strategy and space traffic management and AST’s activities support the growth in the commercial space industry. In addition, the 2012 Budget request supports the *Presidential Task Force on Space Industry Workforce and Economic Development’s* recommendation that FAA establish a Commercial Spaceflight Technical Center. The Technical Center will provide safety and technical support for future commercial space launch activities and support the continued development of standards and regulations for commercial spaceflight. Due to a projected increase in commercial space transportation launches, AST funding will be used to conduct appropriate research and develop necessary regulations related to commercial human spaceflight to ensure public safety.”

The FAA Commercial Spaceflight Technical Center. Many details about the Center are still being developed. AST’s budget request notes that the Presidential Task Force recommended that FAA establish the Center at the Kennedy Space Center, and that its main purpose will be “to develop safety processes and requirements related to commercial human spaceflight (HSF), along with related research. Primary focus areas at the Technical Center will include spaceflight safety, spaceflight engineering and standards, and Space Traffic Management.” In supplementary budget material provided to committee staff, AST also pointed out that establishing the Technical Center at Kennedy will “enable the nation to continue to benefit from the contributions of a significant number of highly-skilled aerospace workers who will

be seeking employment during the next 12 months. It will allow the FAA and NASA to partner in developing an organization with a knowledgeable and experienced staff to regulate future commercial space operations.”

Space Incentives Program. The request seeks \$5 million to establish a program for incentivizing advancements in space transportation by non-governmental organizations. Modeled on previous successful prize programs (e.g., the Ansari X Prize), AST proposes to put up a \$5 million award for industry to develop and demonstrate a low-cost launch system for CubeSats. These are very small low-cost satellites (10 x 10 x 10 cm) that are favored by universities and other research institutions, and are typically carried as secondary payloads on conventional satellite launches. Should the prize program produce a winning design, it would enable frequent dedicated low-cost missions carrying one or several CubeSats.

Commercial Space Launch Amendments Act of 2004

In 2004, SpaceShipOne successfully launched two suborbital flights from the Mojave, CA, airport within a two week time-span, winning the \$10 million Ansari X-Prize. Space industry optimists believed then that suborbital flights carrying space tourists would quickly develop with several commercial companies entering the marketplace to offer routine suborbital flights. Later that year Congress passed H.R. 5382 (P.L. 108–492), the Commercial Space Launch Amendments Act of 2004, authorizing the Secretary of Transportation to license and regulate commercial human space flight.

However, even though the Act extended regulatory authority to DOT (specifically to the Office of Commercial Space Transportation), it prohibited federal regulation of commercial human space flight companies for eight years following enactment. This prohibition covers both suborbital and orbital commercial launch systems.

The premise of the eight-year prohibition was rooted in the concern that the industry did not yet exist, and thus DOT (and AST) had no relevant experience upon which to regulate industry practices. During this period, space launch companies would be able to experiment with various designs and processes as they endeavored to improve their vehicles’ safety and performance prior to offering licensed suborbital (or orbital) flights. The Act provided two exceptions to the regulatory prohibition; AST could restrict or prohibit design features or operating practices that (1) resulted in a serious or fatal injury to crew or space flight participants, or (2) contributed to an unplanned event during a commercial human space flight that posed a high risk of causing a serious or fatal injury to crew or space flight participants. The eight year ban expires December 23, 2012.

Thus the increase in AST’s FY2012 budget request is predicated on the expiration of the ban and with it the need to develop the technical expertise, and to hire industry veterans. Their budget request states: “The FY2012 request reflects the addition of crew and passenger safety to our regulatory activities.”

The regulatory prohibition may be modified by Congress. On March 31, 2011, during House consideration of H.R. 658, the FAA Air Transportation and Modernization and Safety Improvement Act of 2011, an amendment was adopted by the House that, among other provisions, extended the regulatory prohibition for another eight years following the date of the first licensed commercial human space flight launch. The Senate companion bill had no comparable provision.

To date only one company, Virgin Galactic, is known to be actively testing a prototype sub-orbital commercial human spaceflight vehicle. SpaceShipTwo, a larger version of the Ansari X-Prize winner, is undergoing unpowered atmospheric testing in California. According to the company, hundreds of interested purchasers have already placed down-payments with Virgin Galactic for the privilege of flying on their spacecraft once commercial flights get underway.

NASA’s Commercial Cargo and Crew Programs

With the retirement of the Space Shuttle this summer, NASA plans to rely on two companies—Orbital Sciences Corporation (Orbital) and Space Exploration Technologies (SpaceX)—to provide cargo resupply services to the International Space Station until 2020. Under the current contracts each company is obligated to launch two supply flights a year, and with regard to SpaceX, it would also bring materials back from ISS using their Dragon capsule to reenter the atmosphere and land at a permitted site. For these resupply flights NASA is buying a service as though it were a traditional commercial customer, thus triggering coverage under AST’s licensing regime. Once both companies are operating resupply flights on a routine basis, AST’s regulatory workload will increase by four flights a year, plus two reentries.

NASA is also pursuing a longer term strategy to use a similar approach of buying launch services to ferry astronauts to and from the International Space Station, although agency plans are still uncertain about when these “commercial crew” flights will begin. Most of the agency’s notional plans suggest 2016 as a likely date, though many technical hurdles still remain, not the least of which is NASA publishing a set of human rating requirements to be met by any of the commercial launch bidders.

Non-NASA flights would also require a new set of regulations be established and enforced by AST to ensure that the risk to non-governmental crew and passengers are minimized. NASA has vast experience in this arena while AST has none. FAA (AST) and NASA are in discussions now about how the two agencies will exercise oversight and insight into the design and operation of any commercial orbital crew launch systems, as well as their reentry performance, landing sites, and recovery operations. The goal is to minimize any overlap between the agencies.

On Thursday, April 28, 2011, AST published a notice on its website that it will hold a public meeting late this month in Florida to seek input from the affected community. “FAA is planning to propose regulations to protect the health and safety of crew and space flight participants for orbital human spaceflight as soon as circumstances require after December 23, 2012” (the end of the eight year regulatory prohibition now in current law).

Chairman PALAZZO. The Subcommittee on Space and Aeronautics will come to order.

Good morning. Welcome to today's hearing entitled "The Office of Commercial Space Transportation's Fiscal Year 2012 Budget Request." In front of you are packets containing the written testimony, biographies and Truth in Testimony disclosures for today's witness panel. I recognize myself for five minutes for an opening statement.

Today, May 5th, marks the 50th anniversary of the first flight of an American astronaut, and the second human being into outer space. Alan Shepard, riding in a Mercury capsule, launched atop a Redstone rocket on a 15-minute suborbital flight that carried him to an altitude of 116 miles. His flight was a major first step for America's space program, helping bolster American pride and setting our country and NASA on a spectacular course of space accomplishments.

Turning to the present, I want to thank our witnesses for taking time from their busy schedules to appear before our Subcommittee. I realize a lot of work by many people goes into the preparation of your statements, and I want to assure you that your expertise and wisdom will be valuable to this Committee and Congress as we wrestle with issues related to our Nation's commercial space program.

The Office of Commercial Space Transportation provides an essential public service, ensuring that commercial launches are undertaken with the highest level of safety. Their record of achievement is significant, licensing over 200 launches without any loss of life, serious injury, or notable property damage to the general public.

However, over the next several years AST, as they are commonly known within FAA and industry, faces an increased workload and possible added regulatory duties, and their fiscal year 2012 budget request reflects these new burdens. The request seeks a 75 percent increase over the fiscal year 2010 enacted level and an expansion of its workforce by nearly 50 percent. A significant portion of the increase would be spent hiring additional staff to develop and implement new safety requirements for suborbital and orbital commercial human spaceflight launch systems. AST also proposes to establish a new program modeled after NASA's Centennial Challenges prize to incentivize development of space transportation technologies. Finally, the budget request proposes creation of a Commercial Spaceflight Technical Center at NASA's Kennedy Space Center that would initially employ a small number of aerospace engineers, but could over time hire as many as a couple hundred. The request is silent on associated infrastructure costs.

With respect to commercial human spaceflight, the Commercial Space Launch Amendments Act of 2004 included two provisions that will be central to our discussions today. The first authorized AST to regulate commercial human space flight launch systems; the second prohibited AST from regulating commercial human spaceflight for eight years in order to give space tourism companies an opportunity to design, develop, and operate new and experimental launch systems. The freeze was expected to allow the nas-

cent industry to gain experience through experimental flights upon which AST could rely as it began to draft a regulatory regime.

At the time Congress was considering the 2004 Act, industry expressed concern that without any real-world experience, regulation writers could choke off creation of the space tourism marketplace by writing and enforcing unworkable and overly prescriptive rules.

Roughly 6-1/2 years have elapsed since the bill's enactment, and as many in this room are aware, there is an effort underway in Congress to extend the regulatory prohibition another eight years. Given that no prototype commercial suborbital vehicle has yet flown into space, does the argument still hold that AST needs an experience base upon which it can draft regulations guiding the industry's design and operation of their vehicles? To what degree should AST regulate commercial human space launch systems? Should they have insight down to the component level for each type of launch vehicle, much the same way that FAA certifies commercial civil aircraft? How would they acquire the knowledge and expertise to take on this role? It is my hope this morning's hearing will help shed light on these and other pressing questions.

Before closing, I also want to express concerns about AST's proposal to create a prize program. While I appreciate government's interest in promoting technological development in the space transportation industry, it is my view that NASA is doing more than a sufficient job funding new technologies and capabilities through aggressive use of Space Act agreements. In these times when Congress and the White House are focusing on reducing the federal budget deficit, I question the wisdom of implementing another form of federal largesse.

Dr. Nield, don't take this personally, but I want the record to note that the FAA's testimony was provided to our Committee about 20 hours ago contrary to Committee rules and past practice. By holding back testimony, Members and staff are afforded only a handful of hours to review and analyze Administration statements, undermining the ability of this body to engage in a well-informed dialog with Executive Branch witnesses. The White House's process for vetting testimony of agency witnesses continues to frustrate this Committee and Congress. This is not the first time in this still-young Congress that testimony has arrived only hours before the scheduled start of hearings, and I urge the White House to exercise greater diligence.

[The prepared statement of Mr. Palazzo follows:]

PREPARED STATEMENT OF CHAIRMAN STEVEN M. PALAZZO

Good morning and welcome to today's hearing to discuss the Fiscal Year 2012 budget request submitted by the FAA Office of Commercial Space Transportation.

Today, May 5th, marks the 50th anniversary of the first flight of an American astronaut - and the second human being - into outer space. Alan Shepard, riding in a Mercury capsule, launched atop a Redstone rocket on a fifteen minute sub-orbital flight that carried him to an altitude of 116 miles. His flight was a major first step for America's space program, helping bolster American pride and setting our country and NASA on a spectacular course of space accomplishments.

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Roughly six-and-a-half years have elapsed since the bill's enactment, and as many in this room are aware, there is an effort underway in Congress to extend the regulatory prohibition another eight years. Given that no prototype commercial sub-orbital vehicle has yet flown into space, does the argument still hold that AST needs an experience base upon which it can draft regulations guiding the industry's design and operation of their vehicles? To what degree should AST regulate commercial human space launch systems? Should they have insight down to the component level for each type of launch vehicle, much the same way that FAA certifies commercial civil aircraft? How would they acquire the knowledge and expertise to take on this role? It is my hope this morning's hearing will help shed light on these and other pressing questions.

Before closing, I also want to express concerns about AST's proposal to create a prize program. While I appreciate government's interest in promoting technological development in the space transportation industry, it is my view that NASA is doing more than a sufficient job funding new technologies and capabilities through aggressive use of Space Act Agreements. In these times when Congress and the White House are focusing on reducing the federal budget deficit, I question the wisdom of implementing another form of federal largesse.

Dr. Nield, don't take this personally, but I want the record to note that the FAA's testimony was provided to our committee about 20 hours ago, contrary to committee rules and past practice. By holding back testimony, Members and staff are afforded only a handful of hours to review and analyze administration statements, undermining the ability of this body to engage in a well-informed dialogue with executive branch witnesses. The White House's process for vetting testimony of agency witnesses continues to frustrate this committee and Congress. This is not the first time in this still-young Congress that testimony has arrived only hours before the scheduled start of hearings, and I urge the White House to exercise greater diligence.

Chairman PALAZZO. The Chair now recognizes Mr. Costello for an opening statement.

Mr. COSTELLO. Mr. Chairman, thank you, and I thank you for calling the hearing today, and let me just associate myself with your remarks about testimony coming from the White House in a timely manner consistent with the rules of this Committee. It has been a longstanding problem. I have been on this Committee for a number of years, and we experience the same problem regardless of which Administration is in office, and I would just say to you to

go back, Dr. Nield, and express our frustration. As the Chairman said, don't take it personal but we know the vetting process needs to—you all need to do a better job in the White House. We expressed that under the Bush Administration. We will continue to express that under the Obama Administration.

Mr. Chairman, I am very familiar with commercial space transportation and the commercial space transportation industry, not only from the hearings that I Chaired in the Aviation Subcommittee but also from the X-Prize Foundation, which is well known for designing and managing public competitions for aviation and space. They are located across the river, in St. Louis, Missouri, from my Congressional district in southwestern Illinois.

AST's fiscal year 2012 budget request reflects the office's changing role as the commercial spaceflight industry expands to provide cargo and crew transportation for NASA, build spaceports around the country, transport space tourists, and fulfill other missions. Congress and the FAA will need to decide how best to proceed with respect to safety regulations of this emerging industry.

Congress passed several laws to allow commercial space transportation to develop, and we must ensure the industry has proper federal safety oversight. As the number of launches is expected to increase with commercial space tourism and the potential use of commercial space launch vehicles by NASA, it is imperative that the FAA has the proper resources to ensure new technologies and programs evolve safely.

I look forward to hearing from the FAA Associate Administrator for Commercial Space Transportation about FAA's role in overseeing the commercial space industry to ensure the safety of the public, as well as crew and spaceflight participants. I hope this hearing will be the first of many substantive hearings by this Subcommittee to examine the current status and future challenges of commercial space operations. We need to determine our goals for the Office of Commercial Space Transportation and evaluate the issues we must consider for the future of the AST.

I welcome our witnesses and look forward to hearing their testimony. Again, I thank you, Mr. Chairman, and I yield back and look forward to hearing from our witnesses.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF ACTING RANKING MEMBER JERRY COSTELLO

Mr. Chairman, thank you for holding today's hearing to review the Fiscal Year 2012 (FY12) budget request for the Federal Aviation Administration's (FAA's) Office of Commercial Space Transportation (AST).

I am very familiar with the emerging commercial space transportation industry, not only from hearings I Chaired in the Aviation Subcommittee, but also because the X-Prize Foundation, which is most well known for designing and managing public competitions for aviation and space, is located in St. Louis, Missouri —across the river from my Congressional district.

AST's FY12 budget request reflects the office's changing role as the commercial spaceflight industry expands to provide cargo and crew transportation for NASA, build space ports around the country, transport space tourists, and fulfill other missions. Congress and the FAA will need to decide how best to proceed with respect to safety regulation of this emerging industry.

Congress passed several laws to allow commercial space transportation to develop and we must ensure the industry has proper federal safety oversight. As the number of launches is expected to increase with commercial space tourism and the potential use of commercial space launch vehicles by National Aeronautics and Space

Administration (NASA), it is imperative that the FAA has the proper resources to ensure new technologies and programs evolve safely.

I look forward to hearing from the FAA Associate Administrator for Commercial Space Transportation, Dr. George Nield, about FAA's role in overseeing the commercial space industry to ensure the safety of the public, as well as crew and space flight participants.

I hope this hearing will be the first of many substantive hearings by this subcommittee to examine the current status and future challenges of commercial space operations. We need to determine our goals for the Office of Commercial Space Transportation and evaluate the issues we must consider for the future of the AST.

I welcome our witnesses and look forward to their testimony.

Thank you, Mr. Chairman, and I yield back the balance of mytime.

Chairman PALAZZO. Thank you, Mr. Costello.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

At this time I would like to introduce our witness panel. Our first witness is Dr. George Nield, Associate Administrator for Commercial Space Transportation at the FAA. He has over 30 years of aerospace experience with the Air Force, NASA, and private industry. Dr. Nield came to FAA from the Orbital Sciences Corporation, where he served as Senior Scientist for the Advanced Programs Group. Our next witness is Dr. Gerald Dillingham, Director of Civil Aviation Issues at the U.S. Government Accountability Office. He is responsible for directing program evaluations and policy analysis related to all aspects of civilian aviation including safety, finance, environment, air traffic control, airport development, and international aviation issues. Our final witness is Dr. Henry Hertzfeld, Research Professor of Space Policy and International Affairs in the Space Policy Institute at the Elliott School of International Affairs and an Adjunct Professor of Law at George Washington University in Washington, DC. Welcome to all of you.

As our witnesses should know, spoken testimony is limited to five minutes each after which the Members of the Committee will have five minutes each to ask questions.

I now recognize our first witness, Dr. George Nield, Associate Administrator for Commercial Space Transportation at the FAA.

**STATEMENT OF DR. GEORGE C. NIELD,
ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE
TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION**

Dr. NIELD. Chairman Palazzo, Congressman Costello and Members of the Subcommittee, thank you for inviting me to participate in this hearing on the activities of the Federal Aviation Administration Office of Commercial Space Transportation. This is my first opportunity to speak to many of you, so I am particularly pleased to be here. I know the Subcommittee is specifically interested in the Administration's fiscal year 2012 budget request for AST. I would also like to update the Subcommittee on some of our recent activities and offer you our view of the future.

The mission of the Office of Commercial Space Transportation is to ensure protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch and reentry activities, and to encourage, facilitate and promote commercial space transportation.

While we take all of our statutory charges seriously, our top priority is safety. To carry out our safety responsibilities, we develop and issue regulations, grant licenses, permits and safety approvals, and conduct safety inspections during every licensed or permitted launch. To date, we have an unblemished safety record: 204 licensed launches without any loss of life, serious injuries, or significant property damage to the general public.

We are also responsible for licensing the operation of launch and reentry sites, or spaceports. Since 1996, we have licensed the operation of eight different spaceports around the country. Last year, the FAA awarded four grants for spaceport development. We believe these investments will enhance safety and facilitate future development efforts.

The capability to accomplish important commercial space transportation research was significantly enhanced last fall through the establishment of the Center of Excellence for Commercial Space Transportation led by New Mexico State University. The Center of Excellence is a partnership between government, industry and academia, and will carry out research necessary to maintain U.S. leadership in commercial space transportation safety and technologies.

Fifty years ago on May 5, 1961, Alan Shepard became the first American to travel into space, but today, we find ourselves at a crossroads. Next month, NASA will carry out the final launch of the space shuttle. While this is a bittersweet event for all space enthusiasts, it is also an exciting time and an opportunity to begin the next chapter in space transportation.

After the completion of Atlantis's final mission, NASA is planning to rely on private industry to launch cargo and eventually crew members to and from the International Space Station, thereby enabling NASA to focus its attention on exploring the solar system. It will be the FAA's responsibility to license and regulate those commercial launches to the ISS.

One of the most important contributors to our near-term workload will be suborbital space flights. In fiscal year 2012, we expect to see several dozen licensed or permitted launches, many of which will involve suborbital flights. That will mark a significant increase in activity for us, and it represents the start of what is likely to be a period of sustained and rapid growth.

The Administration's fiscal year 2012 budget request for AST totals approximately \$26.6 million and provides for 103 full-time employees. The request includes funding for a Commercial Spaceflight Technical Center at the Kennedy Space Center in Florida and a low-cost access to space incentive program. I would be happy to discuss each of these initiatives in more detail if there is interest.

Commercial space transportation is currently undergoing a number of changes, and as the regulator, we need to be prepared to change along with the industry. For example, in the coming months, it may be necessary to revisit some of the statutes and regulations that govern commercial space launch activities. Specifically, the FAA's legislative authority may require revision so that we can continue to ensure public safety both in space and on the ground. We see the potential for greater regulatory authority in the area of on-orbit transportation as well as during launch and re-

entry. We welcome the opportunity to work with Congress on these priorities.

Chairman Palazzo, Congressman Costello and Members of the Subcommittee, this concludes my prepared remarks. I would be pleased to answer any questions that you may have.

[The prepared statement of Dr. Nield follows:]

PREPARED STATEMENT OF DR. GEORGE C. NIELD,
ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION,
FEDERAL AVIATION ADMINISTRATION

Chairman Palazzo, Congressman Costello, and Members of the Subcommittee:

Thank you for inviting me to participate in this hearing on the activities of the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST). This is my first opportunity to speak to many of you, so I am particularly pleased to be here. I know the Subcommittee is specifically interested in the Administration's FY 2012 budget request for AST. I look forward to answering any questions you may have about our request. I would also like to take this opportunity to update the Subcommittee on some of our recent activities, to highlight some of the changes to our industry during the past year, and to offer a view of the future - what's on the horizon as we transition to a new role for the nation's commercial space transportation industry.

The Office of Commercial Space Transportation

The Office of Commercial Space Transportation (AST) was established by Executive Order in 1984 and was located in the Office of the Secretary of Transportation. In November of 1995, the office was transferred to the FAA, where today it is one of the agency's four lines of business, along with the Office of Aviation Safety, the Office of Airports, and the Air Traffic Organization.

Space transportation activities in the United States fall into three main sectors: the civil sector, where the National Aeronautics and Space Administration (NASA) has the primary lead; the national security sector, involving the Department of Defense and the intelligence community; and the commercial sector, which is regulated by the FAA. In accordance with federal statute, it is the mission of AST to ensure protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch and reentry activities, and to encourage, facilitate, and promote commercial space transportation. While we take all of our statutory charges seriously, our top priority is safety. To carry out our safety responsibilities, we develop and issue regulations; grant licenses, permits, and safety approvals; and conduct safety inspections during every licensed or permitted launch. To date, we have an unblemished safety record: 204 licensed launches, without any loss of life, serious injuries, or significant property damage to the general public.

We are also responsible for licensing the operation of launch and reentry sites or "spaceports," as they are popularly known. Since 1996 we have licensed the operation of the California Spaceport at Vandenberg Air Force Base; Spaceport Florida at Cape Canaveral Air Force Station; the Mid-Atlantic Regional Spaceport at Wallops Flight Facility in Virginia; Mojave Air and Space Port in California; Kodiak Launch Complex on Kodiak Island, Alaska; the Oklahoma Spaceport in Burns Flat, Oklahoma; Spaceport America near Las Cruces, New Mexico; and Cecil Field in Jacksonville, Florida.

Development of these sites is necessary for the growth and success of the industry. In FY 2010, the FAA awarded four grants for spaceport development. These investments will facilitate safety and growth of future spaceport development and should ultimately inspire additional private investment in commercial space transportation.

Commercial space transportation research efforts were enhanced last year by the establishment of the Center of Excellence for Commercial Space Transportation, led by New Mexico State University, Las Cruces. The other institutions that comprise the center include Stanford University; the Florida Institute of Technology in Melbourne; the New Mexico Institute of Mining and Technology in Socorro; the University of Colorado at Boulder; the University of Texas Medical Branch, Galveston; and the Florida Center for Advanced Aero-Propulsion—a research consortium made up of the University of Florida, Florida State University, and the University of Central Florida. The Center of Excellence is a partnership between academia, industry, and

government, and will carry out research necessary to maintain U.S. leadership in commercial space transportation safety and technology.

Additionally, the FAA maintains important relationships with our interagency partners. We continue our partnership with the Air Force through our Common Standards Working Group where we coordinate on safety issues for expendable launch vehicles. We also work with the White House Office of Science and Technology Policy, NASA, and the Departments of Commerce, State, and Defense in the development of interagency policy for the industry, including the new National Space Policy released in 2010. We consult with the Department of State regularly to promote our commercial space transportation guidance abroad.

The Administration's 2010 National Space Policy establishes specific goals to strengthen stability in space by, among other things, promoting safe and responsible operations in space. This will require steps such as collecting and monitoring detailed knowledge of the orbital environment, and the sharing of that information with a variety of space actors. It will also be important to continue taking steps to minimize the creation of orbital debris and otherwise help preserve the space environment for responsible, peaceful, and safe activities by all users. Over time, the FAA will play a central role in developing and enhancing our nation's capacity to conduct such efforts, along with the Departments of Defense, State, and Commerce; the Office of the Director of National Intelligence; NASA; and the Federal Communications Commission. This collaboration will provide global benefits.

Today and Moving Forward

As the FAA continues the work of overseeing and enabling the safe development of the commercial space transportation industry, the space community as a whole finds itself at a crossroads. Last month, we celebrated the 50th anniversary of human space flight. Next month, NASA will conduct its final Space Shuttle launch. While this is a bittersweet event for all space enthusiasts, it is also an exciting time and an opportunity to begin the next chapter in space access, transportation, and development. After the completion of Atlantis' final mission, NASA is planning to rely on private industry to launch cargo, and eventually crew members, to and from the International Space Station (ISS), thereby enabling NASA to focus its attention on exploring the solar system. FAA is engaging with NASA to further refine the licensing and regulatory process for these upcoming commercial crew launches to the ISS.

Throughout the past 50 years, NASA has become the world leader in human spaceflight, amassing vast experience and a wonderful track record in space travel. There is no equal.

Similarly, during the past 50 years, the FAA has achieved a stunning record of safety in commercial aviation. We are now leveraging that half-century of experience and safety acumen in our regulation and oversight of the commercial space transportation industry.

Working in tandem, the FAA and NASA can bring best practices and our best experiences to bear on the future development of a safe and robust commercial human spaceflight industry for our nation - a priority of the Administration. Working with NASA and other experts, we can ensure the United States maintains its leadership role as human space flight becomes a reality for the commercial industry and private sector development increases to meet demand.

One of the concerns we have heard expressed, and which Members of this Subcommittee may share, pertains to the demand for commercial launches to low Earth orbit: Is there a market? What does that market look like now and in the future? Is it sustainable?

To answer these questions, Congress directed NASA, in coordination with the FAA, to conduct an assessment of the potential non-Governmental market for commercially developed crew and cargo transportation systems and capabilities (apart from the more established market for launched commercial spacecraft). Assessments by NASA and the FAA reveal a diversity of opinion among the space community regarding the size of the non-Governmental market for commercial crew and cargo launches, as well as the price of a ticket to space. The NASA report concluded that "catalyzed by a successful Commercial Crew Program, a stable commercial non-Government market is likely to emerge." NASA investments to date have paid huge dividends for industry, providing new capabilities and enabling the development of new, lower-cost launch systems.

Multiple American companies—including small, entrepreneurial enterprises and large, established aerospace corporations—have announced that they are ready, willing, and able to meet NASA's future needs, as well as those of non-Governmental customers.

The future of commercial cargo and crew transportation to low Earth orbit is a coming reality, but the largest near-term expansion in activity will be in suborbital spaceflight. In calendar year 2010, there were four licensed orbital launches: two Falcon 9 test flights and two satellite deployment missions—a Delta II and a Delta IV. That same year, we saw the first FAA-licensed reentry, of SpaceX's Dragon capsule. In FY 2012, we expect several dozen licensed or permitted launches. Although most of those missions will involve suborbital launches, it still will be quite a change. The dramatic increase in launch numbers will provide the FAA and the space community with important data and facilitate significant improvements throughout the industry.

The President's FY 2012 Budget

The Administration's FY 2012 budget request for AST totals approximately \$26.6 million and provides for 103 full-time employees (FTEs), at a cost of approximately \$15.8 million. The office's request for non-pay activities totals approximately \$10.8 million. Key outputs of the request include a projected 6 license and permit applications, 40 launch or reentry operations inspections, 8 launch site inspections, 5 environmental assessments, plus new rulemaking products, the Commercial Space Flight Technical Center, the Center of Excellence for Commercial Space Transportation, and incentives for low cost access to space. The budget requests \$1.2 million and 14 positions to develop and implement additional safety processes and requirements specifically for commercial human spaceflight and the FAA's efforts to improve spaceflight safety.

Commercial Space Flight Technical Center

The budget request for AST includes \$5 million and 50 positions for a Commercial Spaceflight Technical Center. In anticipation of the commercial cargo launches to the ISS that are scheduled to begin this year and with plans for eventual commercial crew missions, it will be vitally important to enhance and ensure the highest levels of safety for commercial spaceflight operations. The staffing and activities planned for the Commercial Spaceflight Technical Center will provide the detailed engineering and operational expertise that will be required to oversee the emerging commercial spaceflight industry.

Specifically, the Commercial Spaceflight Technical Center will perform several functions: spaceflight safety, including safety inspections, and accident prevention and investigation activities; spaceflight engineering and standards, to be developed in cooperation with both NASA and the industry, for spacecraft, spaceports, flight crew and participants, and aerospace technicians; range operations, including planning for future upgrades; and facilitating interagency coordination and information sharing with regard to space situational awareness, orbital debris, and collision avoidance advisories.

On August 15, 2010, the Presidential Task Force on Space Industry Workforce and Economic Development recommended that FAA establish the new Center at the Kennedy Space Center in Florida. By co-locating the new Center at the Kennedy Space Center, we hope to benefit from the contributions of a significant number of highly skilled aerospace workers who will be seeking employment during the next 12 months. Additionally, this co-location will allow the FAA and NASA to further strengthen our partnership by developing a knowledgeable and experienced staff to regulate future commercial space operations, and to develop the technical standards that will be needed for this emerging and critically important industry.

Although the relationship between the Commercial Spaceflight Technical Center and NASA will be vital, the Center will not duplicate NASA functions. NASA has a separate mission and is focused on activities such as the safety of its personnel during transport to and from the ISS, operation of the ISS, development of a new Heavy-Lift launch vehicle, robotic and human exploration of the solar system, Earth and space science, and aeronautics. The FAA is a regulatory agency and has the statutory responsibility to oversee commercial space launches and reentries, and to ensure public safety during these operations. Establishment of the Commercial Spaceflight Technical Center will enable the FAA to strengthen its partnership with NASA, drawing on NASA's expertise and experience in space operations and human space flight to augment the FAA's experience in licensing and regulating commercial launches to develop a highly skilled cadre of commercial space hardware and operations experts.

Low-Cost Access to Space Incentive

The FY 2012 budget request also includes \$5 million to incentivize advancements in the commercial space transportation industry. The Low Cost Access to Space Incentive program will provide a \$5 million award to the first non-governmental team

to develop and demonstrate the capability to launch a 1-kilogram cubesat to orbit using a partially reusable launch system. The Administration believes that prizes and challenges have many potential benefits, including increasing the number of organizations that are addressing a particular problem of national significance, stimulating private sector investment that is many times greater than the cash value of the prize, and allowing the Federal Government to pay only for results.

The high cost of access to space has long been a major obstacle for civil, military, and commercial space programs. The dream of low cost, fully-reusable space launch systems has recently been demonstrated by the X-Prize competitions, but only to suborbital space. This competition will achieve significant reductions in the cost of getting satellites to orbit.

The Space Incentive Program follows a long tradition of prize competitions, including the AnsariX Prize won by Scaled Composites SpaceShipOne in 2004 and the Orteig Prize won by Charles Lindbergh in 1927. These awards can lead to significant accomplishments in transportation, and the use of prizes has been very successful in enabling government and industry to come up with innovative solutions to challenging problems. This incentive is expected to increase the number of developers and operators focusing on the specific problem of reusable, low-cost, orbital space launch systems, and we believe it is of sufficient size to attract the investment and commitment of companies who are capable of winning the prize.

Preparing for the Future

The FAA stands ready to meet the changes and challenges we know are coming. The industry has made significant strides toward a future that will make increasing demands on the FAA's role as a regulator. As activities expand in the marketplace, our role will amplify as well. To this end, we are constantly looking ahead.

In the coming months and years, it may be necessary to revisit some of the statutes and regulations that govern the commercial space launch activities of the FAA. Specifically, the FAA's legislative authority may require expansion to ensure public safety in space and on Earth, as the commercial space flight sector evolves. Potentially, there may be a need for greater regulatory authority in the areas of transportation on orbit as well as launch and reentry. In addition, the FAA's licensing authority may also require revision regarding operations associated with commercial hybrid launch systems and commercial cargo vehicles intentionally returning to Earth, regardless of whether they return substantially intact. We welcome the opportunity to work with Congress on these priorities.

In this time of challenge and opportunity, the FAA is mindful of our many responsibilities, and we look forward to working with this Subcommittee as we tackle the challenges of shifting cargo and crew launches to the commercial sector and opening space to tourism and point-to-point transportation. The commercial space industry is ready to expand—and with your support, we are ready for lift-off.

Chairman Palazzo, Congressman Costello, and Members of the Subcommittee, this concludes my prepared remarks. I would be pleased to answer any questions you may have.

Chairman PALAZZO. Thank you, Dr. Nield.

I now recognize our second witness, Dr. Gerald Dillingham, Director of Civil Aviation Issues for the U.S. Government Accountability Office.

STATEMENT OF DR. GERALD DILLINGHAM, DIRECTOR, PHYSICAL INFRASTRUCTURE, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Dr. DILLINGHAM. Thank you, Mr. Chairman, Mr. Costello, Members of the Subcommittee.

My testimony this morning focuses on three areas. First, the recent trends in the commercial space launch industry, and second, fiscal year 2012 budget request for FAA's Office of Commercial Space Transportation, or AST, and third, some of the key challenges that FAA and the industry will need to address as the industry matures.

Regarding the trends in the industry, after reaching a peak of 22 launches in 1998, the frequency of commercial space launches began to fluctuate and generally decline until an uptick occurred

in 2004. In 2004, five manned commercial test flights took place, and since that time additional manned flights have been anticipated but have not materialized. However, other trends seem to indicate that the number of commercial launches is expected to increase. For example, there has been an increase in R&D activities including low-altitude flight tests, reusable rocket-powered vehicles that are capable of takeoffs and landings. We also see where private companies and states are developing additional spaceports to accommodate anticipated space tourism flights and expand the Nation's launch capacity. In 2006, there were six FAA licensed spaceports. In 2011, the number has increased to eight. Additional commercial spaceports have been proposed in Hawaii, Indiana and Wisconsin.

Now, let us turn to AST's fiscal year 2012 budget request. FAA expects the number of commercial launches will increase over the next several years for several reasons. First, the first space tourism flights are expected to begin within two years with several launches occurring each year. Second, NASA plans to use private companies to transport cargo and eventually personnel to the International Space Station. FAA also expects its workload to increase over the next several years as it begins to develop safety regulations for these flights, so it has significantly increased its budget request. FAA's fiscal year budget request would increase the budget for AST by nearly 75 percent over fiscal year 2010 budget to about \$27 million in fiscal year 2012. According to FAA, this would fund nearly a 45 percent increase in staffing from 71 Full-time Equivalents in fiscal year 2010 to 103 in fiscal year 2012. This request also asks for a \$5 million increase in spending on the office's space incentive awards program.

From our perspective, FAA's focus on the need to expand its expertise in the areas of human factors and human spaceflight appear reasonable. However, the timing of the requested increase, given the current federal budget situation and uncertainties as to when and how much FAA's workload will expand, warrants careful consideration by the Congress.

Mr. Chairman and Members of the Subcommittee, let us turn to the challenges we see on the horizon for FAA's oversight for the industry as it continues to mature. First, FAA must ensure that its regulations on licensing and safety requirements for launches and launch sites, which are based on safety requirements for expendable launch vehicle operations at federal sites, will also be suitable for operations at private sector spaceports.

A second challenge for FAA is its dual mandate to regulate safety and promote human spaceflight. FAA and Congress must remain vigilant to ensure that any relationship between FAA and the commercial space launch industry remains appropriate.

A third challenge for FAA will be to ensure that planning and implementation of NextGen accommodates spacecraft that are traveling to and from space through the national airspace system.

For the industry, a key challenge going forward will be maintaining a strong international competitive position for the U.S. commercial space launch industry. Foreign competitors have historically offered lower launch prices than U.S. providers. As the com-

mercial space launch industry expands, high launch costs and export controls will affect its ability to sell its services abroad.

Finally, an overarching challenge for the industry and the United States is a lack of a comprehensive national space launch strategy. Numerous federal agencies have responsibilities for space activities including FAA, NASA, DOD, State and Commerce. According to a 2009 National Academy of Sciences study, the process of alignment offers the opportunity to leverage resources from various agencies to address such shared challenges as a diminishing space industry base, the dwindling technical workforce, and reduced funding levels.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Dillingham follows:]

PREPARED STATEMENT OF DR. GERALD DILLINGHAM,
DIRECTOR, PHYSICAL INFRASTRUCTURE,
U.S. GOVERNMENT ACCOUNTABILITY OFFICE

GAO

United States Government Accountability Office

Testimony

Before the Subcommittee on Space and
Aeronautics, Committee on Science,
Space, and Technology, House of
Representatives

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COMMERCIAL SPACE TRANSPORTATION

Industry Trends and Key Issues Affecting Federal Oversight and International Competitiveness

Statement of Gerald L. Dillingham, Ph.D., Director
Physical Infrastructure Issues



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Highlights

Highlights of GAO-11-629T, a testimony before the Subcommittee on Space and Aeronautics, Committee on Science, Space, and Technology, House of Representatives

Why GAO Did This Study

Since GAO reported on the commercial space launch industry in 2006 and 2009, the industry has evolved and moved further toward space tourism. Commercial space tourism promises to make human space travel available to the public for the first time. In addition, the National Aeronautics and Space Administration (NASA) plans to use private companies to transport cargo, and eventually personnel, to the International Space Station after NASA retires the space shuttle later in 2011. The Federal Aviation Administration (FAA) oversees the safety of commercial space launches, licensing and monitoring the safety of such launches and of commercial spaceports (sites for launching spacecraft), and promotes the industry.

This testimony addresses (1) recent industry trends, (2) FAA's related budget request for fiscal year 2012, and (3) challenges that FAA and industry faces. This statement is based on GAO's October 2006 report and December 2009 testimony on commercial space launches, updated with information GAO gathered from FAA and industry experts in April and May 2011 on industry trends and recent FAA and NASA actions.

In past work, GAO recommended that FAA take several actions to improve its oversight of commercial space launches, including assessing its future resource needs. FAA has taken some steps to address the recommendations.

View GAO-11-629T or key components. For more information, contact Gerald L. Dillingham at (202) 512-2834 or gillingham@gao.gov.

May 5, 2011

COMMERCIAL SPACE TRANSPORTATION

Industry Trends and Key Issues Affecting Federal Oversight and International Competitiveness

What GAO Found

Historically, the commercial space launch industry focused primarily on putting payloads, such as satellites, into orbit, using launch vehicles that did not return to earth. Such launches have dropped off, and the industry is increasing its focus on space tourism. Five manned commercial flights took place in 2004, demonstrating the feasibility of commercial space tourism. Since then, companies have pursued research and development and are further developing vehicles for manned flights. Concurrently, companies and states are developing additional spaceports to accommodate anticipated commercial space tourism flights. States have provided economic incentives for development, and FAA has helped to support infrastructure development.

FAA also anticipates an increase in commercial launches, which it expects will increase its oversight responsibilities; thus the agency has requested significantly more resources. FAA will become responsible in the near term for the licensing and oversight of the commercial transport of NASA cargo and eventually for the licensing and oversight of space tourism flights and for safety regulations for all human commercial space travel. Anticipating an increase in responsibilities, FAA's fiscal year 2012 budget request would increase spending on commercial space transportation by nearly 75 percent from about \$15 million in actual obligations in fiscal year 2010 to about \$26.6 million in fiscal year 2012. This would fund an increase of about 45 percent in staffing. GAO agrees that FAA's workload is likely to increase but also believes there are uncertainties about how fast the demands on FAA's resources will grow.

In overseeing the commercial space launch industry, including the safety of space tourism, FAA faces several challenges. These include determining whether its current safety regulations are appropriate for all types of commercial space vehicles, operations, and launch sites; continuing to avoid conflicts between its dual role as safety regulator and industry promoter; and addressing policy and procedural issues when it integrates the operations of spacecraft into its next generation air transportation system. The industry faces competitive issues such as high launch costs that affect its ability to sell its services abroad. Finally, coordinating the federal response to the commercial space industry's expansion is an issue for the federal government in the absence of a national space launch strategy for setting priorities and establishing federal roles.

Several Commercial Space Vehicles Being Developed



Sources: Virgin Galactic (left); Blue Origin (middle); and XCOR Aerospace (right).

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to testify today on the fiscal year 2012 budget request and oversight responsibilities of the Federal Aviation Administration's (FAA) Office of Commercial Space Transportation. Historically, commercial space launches carried "payloads," generally satellites, into orbit using expendable launch vehicles—that is, unmanned vehicles that are only used once. These launches took place primarily at federal launch sites. In recent years, however, the industry has changed significantly: now several companies are developing and have begun testing manned, reusable launch vehicles¹ for commercial space tourism. In addition, the National Aeronautics and Space Administration (NASA) plans to retire the space shuttle later in 2011 and begin using commercial launches to carry cargo and possibly astronauts to the International Space Station. To support expected growth in commercial space launches, private companies and states are developing commercial spaceports—sites used for commercial (nongovernment) spacecraft launches. FAA's Office of Commercial Space Transportation is responsible for licensing and monitoring the safety of commercial space launches and commercial spaceports and promoting the industry.

My testimony today focuses on (1) recent trends in the commercial space launch industry, (2) the fiscal year 2012 budget request for FAA's Office of Commercial Space Transportation, and (3) challenges that FAA and industry face as the commercial space launch industry matures. This statement is based on our October 2006 report and 2009 testimony on commercial space launches, and has been updated with information we gathered from FAA and industry experts in April and May 2011 on industry trends and recent FAA and NASA actions, and FAA documents pertaining to its fiscal year 2012 budget request.² Our work on the October 2006 report included reviewing FAA's safety oversight processes. Our work on both the 2006 report and 2009 testimony included interviewing federal government officials and industry representatives to assess FAA's response to emerging industry issues. Appendix I provides an update of

¹A reusable launch vehicle is one that is capable of being launched into space more than once and takes off and returns to the original launch site.

²GAO, *Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry*, GAO-07-16 (Washington, D.C.: Oct. 20, 2006) and *Commercial Space Transportation: Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles*, GAO-10-266T (Washington, D.C.: Dec. 2, 2009).

the actions that FAA has taken in response to our previous recommendations.

We conducted our work during April and May 2011 in accordance with all sections of GAO's Quality Assurance Framework that were relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings in this report.

Commercial Space Launches Have Generally Declined, but Private Companies and States Are Building Commercial Spaceports Due to an Anticipated Increase

The Number of Licensed Commercial Launches Has Declined, but Research and Development Related to Space Tourism Is Increasing

After reaching a peak of 22 launches in 1998 (see fig. 1), the number of commercial space launches declined through 2001. This was due to a downturn in the telecommunications services industry, which had been the primary customer of the commercial space launch industry. Most of these launches were focused on putting payloads (e.g., satellites) into orbit. The 2004 spike in launches was caused, in part, by the five manned flights of SpaceShipOne, the only manned commercial spaceflights to date.

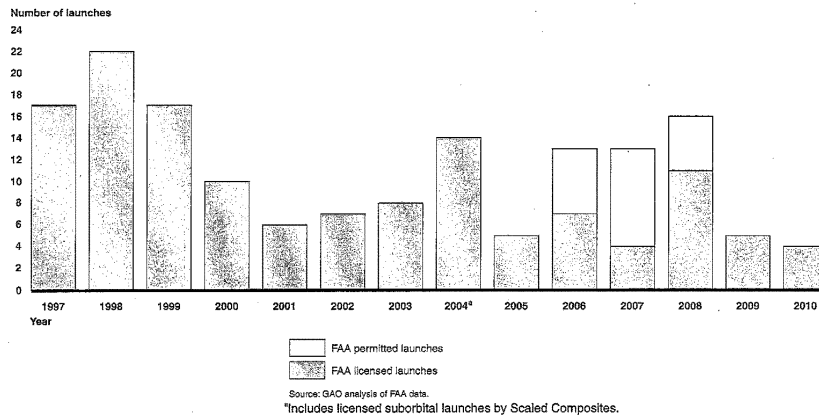
Although anticipated additional manned commercial spaceflights have not materialized, research and development efforts that could lead to manned flights continued following the SpaceShipOne flights. FAA began issuing experimental permits in 2006 to companies seeking to conduct test launches of reusable space launch vehicles, which could be used for

manned commercial flights.³ According to industry experts that we spoke with, since 2006 the commercial space launch industry has experienced a steady buildup of research and development efforts, including ground tests and low-altitude flight tests of reusable rocket-powered vehicles that are capable of takeoffs and landings. In 2009, FAA changed its regulations for amateur rockets, which allowed companies, under certain circumstances, to fly vehicles under the exemption provided by the amateur rocket regulations rather than obtain experimental permits.⁴ For this reason, FAA did not issue any experimental permits in 2009 or 2010. A senior FAA official estimated that a couple dozen permits would have been required during those years if the regulations had not been changed.

³FAA issues four types of licenses: a launch license (for expendable launch vehicles), a reusable launch vehicle mission license, a reentry license, and a launch or reentry site operator license. The first three types of licenses are issued to the operator of a launch vehicle, and the fourth is issued to the operator of a spaceport. FAA also issues experimental permits for test flights of reusable launch vehicles.

⁴73 Fed. Reg. 73768, December 4, 2008. The rule became effective February 2, 2009.

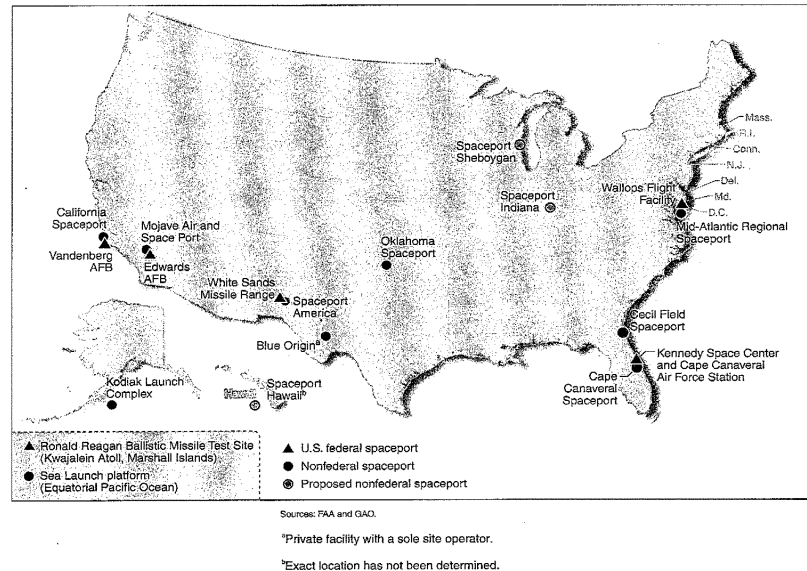
Figure 1: U.S. Commercial Launches 1997 to 2010



The Number of Commercial Spaceports Is Increasing in Anticipation of Increasing Commercial Space Tourism

Since we reported in 2006, private companies and states have been developing additional spaceports to accommodate anticipated commercial space tourism flights and expand the nation's launch capacity. In 2006, there were six FAA-licensed spaceports. In 2011, the number had increased to eight FAA-licensed spaceports—including two in Florida whose licenses were approved since we last reported in 2009. State governments and local communities have proposed establishing commercial spaceports in Hawaii, Indiana, and Wisconsin. Figure 2 shows the existing and proposed commercial spaceports and federal launch sites used for commercial launches.

Figure 2: Existing and Proposed Spaceports in the United States as of January 2011



Both states and FAA have provided support for the development of commercial spaceports. States have provided economic incentives to developers to build spaceports, which will in turn attract space tourism and provide economic benefits to localities. For example, as of June 2010, New Mexico provided approximately \$190 million to construct Spaceport America.⁵ In addition, the Florida Space Authority, a state agency, invested over \$500 million in new space industry infrastructure development, including upgrades to the launch pad, a new space operations support complex, and a reusable launch vehicle support complex. Virginia, which provides funding for the Mid-Atlantic Regional Spaceport, also passed legislation to limit the liability of those providing commercial human spaceflight in the event of an incident and exempt from state income taxes space transportation companies doing business in Virginia and intending to launch payloads or train at the spaceport. However, according to a senior FAA official, continued state support for spaceports in the current economic environment has been mixed. The official added that although there are eight licensed spaceports, there is not activity at all of them, and until there is a user bringing revenue to a location, support is difficult to justify. In addition, in 2010, FAA distributed a total of \$500,000 to four spaceports in the first grants from the Commercial Space Transportation Grant Program.⁶

⁵Approximately \$132 million came from state appropriations. The remainder came from tax bonds collected from Dona Ana and Sierra counties.

⁶Consolidated Appropriations Act, Pub. L. No. 111-117, 123 Stat. 3034, 3039 (2009).

FAA Anticipates That
Increases in
Commercial Launches
and Regulatory
Workload Will Add to
Its Oversight
Responsibilities and
Has Subsequently
Requested More
Resources

FAA's Licensing and
Oversight Responsibilities
Would Expand with the
Commercial Space Launch
Industry

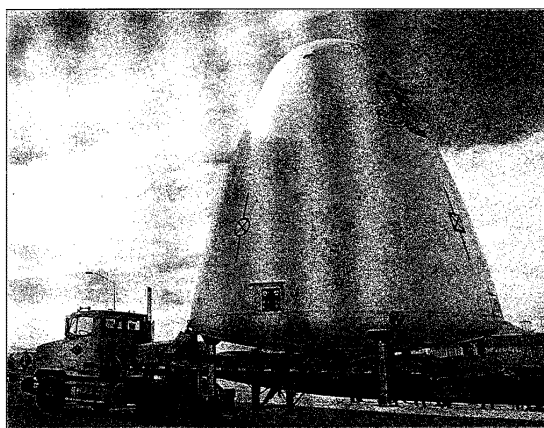
Like the states and private companies building commercial spaceports, FAA expects that the number of commercial space launches will increase over the next several years. This expectation is due, at least in part, to the continued private development of vehicles for human space flight, including space tourism, and NASA-sponsored commercial space launches resulting from the retirement of the space shuttle program in 2011.

According to a senior FAA official and a commercial spaceflight industry official, the first suborbital flights⁷ with paid passengers are expected to begin within 2 years, with several launches occurring each year, adding to the agency's licensing and oversight workload. Each launch, for example, requires both a launch and reentry license. Virgin Galactic, which formed a joint venture with Scaled Composites to develop SpaceShipTwo, is the farthest along among the companies that are undertaking research and development for launch vehicles designed to serve the anticipated space tourism market. The company began conducting related test flights in October 2009. Because those test flights did not use a rocket, they were conducted under FAA airworthiness certificates. Once a rocket is added to the vehicle, as is planned for the next phase of the test flight program, expected to begin later in 2011, an FAA launch license will be required. As

⁷A suborbital flight is one in which the launch vehicle ascends and descends close to the launch site. An orbital flight is one that has an orbital trajectory over the earth. The difference between orbital and suborbital flights is based on the trajectory of the flight rather than altitude.

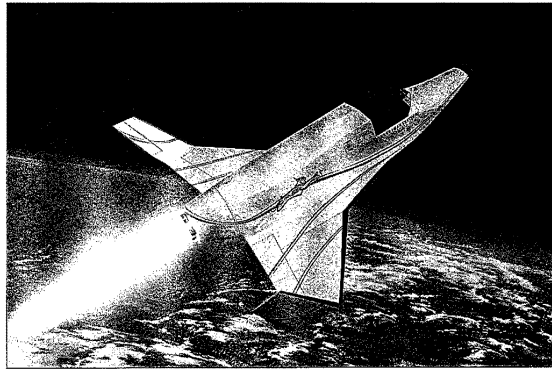
of April 2011, that license was still pending. A Virgin Galactic official said that as of April 2011, over 420 people had placed deposits with the company for future spaceflights. Other companies, such as XCOR Aerospace and Armadillo Aerospace, have also announced plans to develop vehicles to serve the space tourism market. Figures 3-5 show photos of several vehicles that are under development.

Figure 3: Blue Origin's Goddard Space Vehicle



Source: Blue Origin.

Figure 4: XCOR Aerospace's Lynx Space Vehicle



Source: XCOR Aerospace.

Chairman PALAZZO. Thank you, Dr. Dillingham.

I now recognize our final witness, Dr. Henry Hertzfeld, Research Professor of Space Policy and International Affairs at the Elliott School of International Affairs at George Washington University.

**STATEMENT OF DR. HENRY R. HERTZFELD,
RESEARCH PROFESSOR OF SPACE POLICY AND
INTERNATIONAL AFFAIRS, ELLIOTT SCHOOL OF INTER-
NATIONAL AFFAIRS, GEORGE WASHINGTON UNIVERSITY**

Dr. HERTZFELD. Mr. Chairman, thank you for the opportunity to testify today. I am pleased that the Committee has begun the important process of reviewing these matters as the space industry in the United States is poised for very significant changes.

Reviewing the findings of the congressionally mandated 2008 study of human safety regulations and noting important changes in the development of commercial space as well as the environment of space itself, I will discuss both near-term and long-term issues that will need Congressional review.

First, because there have been no commercial suborbital flights yet, the experimental period for the licensing of human suborbital flights will need to be extended. The time period should not have a limit determined by an arbitrary number of years but should be measured by developing indicators of the maturity of the industry and the risks involved. I would recommend that the FAA, perhaps the Commercial Space Transportation Advisory Committee (COMSTAC) or an independent study, determine these types of market indicators. At a future point, when and if suborbital commercial flights develop into a marketable service, the regulatory oversight should be transitioned to other parts of the FAA since these flights will be within airspace and closer in form to aviation than space.

The second issue is an inherent conflict when one agency has the dual mandate to both regulate and promote. The 2008 study found no complaints from industry about the OCST's dual roles. This, though, should be carefully monitored and the promotional aspects might eventually have to be shifted to other agencies to preserve the integrity of the regulatory process.

A related conflict-of-interest problem in the form of one office regulating different competing modes of transportation, in this case Expendable Launch Vehicles (ELVs), Reusable Launch Vehicles (RLVs), suborbital flights and possibly even Unmanned Aerial Vehicles (UAVs), also raise issues of fairness, undue influence, and in the end of making difficult objective decisions regarding safety. In the 2008 study, we noted that there was overlapping jurisdiction in determining who will have the lead if there is a serious commercial space accident. The FAA OCST, through an agreement, delegates that lead to the National Transportation Safety Board (NTSB), which at present does not have a Congressional mandate to investigate space transportation accidents. Also, a law enacted after the Columbia accident, primarily focused on the Shuttle and Space Station, requires a Presidential commission to be formed to lead an accident investigation. However, that same law also applies to a commercial space vehicle that is carrying a government payload. Al-

though all agencies have in the past cooperated fully in these investigations, only one should have the lead responsibility.

A uniform United States approach to regulating in-orbit space activities will become necessary and should be integrated with the licensing procedures for commercial space operations. Difficult issues of in-orbit liability will need to be studied very carefully before these rules are promulgated. At present within the United States, the existing very limited and uncoordinated in-orbit rules are split among the Federal Communications Commission (FCC), the National Oceanic and Atmospheric Administration (NOAA) and the FAA. These should be coordinated.

In addition, there are many international dimensions to in-orbit regulations. If the United States does not take a leadership role and initiate action in this area soon, other nations will. This could lead to international rules that might have negative effects on the growth of U.S. commercial space operations. As we regulate in-orbit activities, the regulatory regime should be clearly delineated between those vehicles that intend to go to outer space and those that will remain within airspace. The regulatory difference involves international obligations the United States has agreed to under the space treaties. A new distinction needs to be clearly made between suborbital vehicles and vehicles that enter outer space but are not intended to achieve orbit.

Finally, Congress might want to revisit the informed consent rules in the CSLA for space participants. I have two suggestions there. One is that the FAA be responsible for drafting clauses dealing with information to be given to the spaceflight participant on accident risk history and other data that the FAA is in a better position to provide than private companies. These clauses should be required to be included in the consent form. However, the companies are still responsible for drafting the form and making it specific to their vehicles.

And secondly, states are starting to compete with their own passenger waivers of liability to the private operator. Currently, Florida, Virginia and recently New Mexico and Texas have these laws, each with different wording. Federal preemption on this issue might be warranted to prevent competition among states on an issue that involves interstate commerce and may adversely affect safety decisions the companies make concerning the vehicle and operations.

Thank you. I will be more than happy to answer questions.
[The prepared statement of Dr. Hertzfeld follows:]

PREPARED STATEMENT OF DR. HENRY R. HERTZFELD,
RESEARCH PROFESSOR OF SPACE POLICY AND INTERNATIONAL AFFAIRS,
ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS, GEORGE WASHINGTON UNIVERSITY

I appreciate the opportunity to testify today on the Federal Aviation Administration's Office of Commercial Space Transportation's role in the supervision and regulation of commercial space flight and am pleased that the Committee has begun the important process of reviewing these matters. The space industry in the United States is poised for very significant changes and it is very timely to begin the process of reviewing national and international issues that will need to be resolved in the years ahead as commercial activity in space grows and evolves.

Since its inception the Office of Commercial Space Transportation (OCST) within the DOT and subsequently within the FAA has actively and successfully developed a regulatory environment for commercial space launches and related activities.

During the past decade the OCST has fulfilled its legislative mandates to regulate commercial spaceflight. It has also licensed private spaceports and other space and space-related activities reflecting the growth of interest and investment in these areas by both entrepreneurs and established companies.

Of particular interest are the Amendments to the CSLA in 2004, which gave the FAA the authority to develop regulations for private human space flight. The regulatory framework was oriented to encouraging the development of commercial human suborbital flights and was stimulated by the success of the X-Prize competition.

However, those promises have not yet, nearly eight years later, resulted in any private paying passengers, although the companies developing those vehicles are still planning to initiate space adventure/tourist businesses.

Beyond the continued promises of suborbital commercial activity there are other new developments. Among them are; 1) NASA plans to send cargo and astronauts to the International Space Station on commercial vehicles, 2) foreign nations are developing new capabilities which will compete with U.S. commercial companies in all space efforts, 3) one U.S. company has plans to transport paying customers to an in-orbit space facility, 4) the Google Lunar X Prize could put a private vehicle on the Moon that might be capable of performing relatively simple activities with commercial value, and 5) commercial UAVs will begin operations which will require new air traffic management in the same high altitudes where suborbital vehicles will fly. These UAVs may have functional capabilities that will compete with suborbital vehicles as well as LEO satellites.

Until recently, the OCST focus for human space flight regulations has been on suborbital vehicles and passengers. The experimental permit period will end soon without any database on flights, safety, or passengers. **This experimental period should be continued, but instead of an arbitrary period of years being designated for the sunset of that provision, other tests should be developed to determine when the regulations should be re-evaluated by Congress.**

Those tests should focus on the availability of enough experience and data from the industry to develop meaningful safety rules. Tests should take into account factors such as;

- The maturity of the business,
- The ability to fly on a routine scheduled basis,
- The number of passengers and the amount of cargo transported or research experiments flown,
- The standardization of vehicles and systems that could provide the basis for a vehicle certification regime, and
- A quantification of the different risks involved.

Ultimately, the safety of both people and property in flight as well as the safety of people and property terrestrially should be the paramount objective of regulations. Rather than go beyond my own technical capabilities and suggest a specific test in this testimony, **I would recommend a panel of appropriate experts (e.g. COMSTAC) be commissioned to study this issue and develop a set of specific recommendations.** While no statistical analysis will be perfect, a more objective set of requirements will better meet the Congressional intent than an arbitrary time horizon.

Five Different Space Regimes (when viewed from a legal/regulatory perspective)

The OCST is primarily organized to license commercial space launches and related activities including spaceports. Congress has given additional responsibility to the FAA OCST to license re-entry space vehicles and, most recently in 2004, to license commercial human space flight.

OCST regulated launch activities include suborbital vehicles that may or may not go into space but are separated from aircraft regulations by a definition based on vehicle propulsion characteristics that have a thrust greater than the lift during the greater part of their ascent

The current division of regulations is fast approaching overlapping and unsettled areas of regulation and jurisdiction. We are at a point where the FAA has to do more than just license ELVs for launch. Specifically, the most difficult future issues will be to regulate commercial in-orbit activities, both for human space flight as well as for other purposes. Because of the growing danger to space operations from the crowding of certain orbits with human-created space debris as well as the projected increased use of commercial services in space by NASA and other government entities, we will need new regulatory authority over in-orbit activity. This involves un-

charted issues of safety as well as financial responsibility to meet the needs of international treaty obligations, the viability of U.S. space operations, and fairness and equity for near-term activities that could have a very long horizon of future responsibilities.

Simply extending the safety review and financial requirements of a launch license regime to include in-orbit activities will not be sufficient to solve the upcoming issues.

In order to try to understand these developing concerns in space regulations, I suggest that we consider the following reorientation of the categories of spaceflight regulation:

The categories are:

Activities under both domestic law and the Outer Space Treaties

1. Launches to Orbit
2. In-orbit activities
3. Non-orbital launches and activities

Activities under domestic law

4. Sub-orbital launches and activities
5. Spaceports

The first three involve activities that fall under the international space treaty obligations and therefore must take into account several factors:

1. Outer space is, through Article II of the Outer Space Treaty (OST), a place without sovereignty;
2. Article VI of the OST makes States Party to the Treaty responsible for government activities and the activities of non-government entities in space as well as requiring continued national supervision;
3. Article VII of the OST makes States liable for their launch activities.

What is unique to space is the requirement of State responsibility and liability. No other industry faces this. In fact, other high technology industries with low probabilities of catastrophic accidents but with a very high probability of severe damage (e.g. civil nuclear power plants, oil platforms) are covered by different treaty obligations. If an accident occurs under those international legal regimes the operator will be primarily responsible and liable with the States party to those treaties and agreements in a position as a guarantor of payment.

The last two categories, suborbital launches and spaceports are domestic, involving the use of national airspace and of terrestrial spaceports. When (and if) sub-orbital markets develop, either for cargo or people, these activities of the OCST should be transitioned to other parts of the FAA, as they are closer to aircraft than to space from a legal regulatory perspective. The question is when to begin that transition.

I would recommend postponing a consideration of any transition of responsibilities for suborbital launches to the indefinite future. As described above, we need to develop a methodology to evaluate the emerging suborbital activity. **When we have the proper amount of data on safety and reliability of the equipment and operating procedures and when the companies have demonstrated that they can operate as a business, then Congress can address this issue.**

In outline format below, I have listed a more detailed description of each category. Currently, only Category 2 (in-orbit activities) and possibly parts of Category 3 (non-orbital activities) are largely unregulated and will require a thorough study of three serious issues: 1) liability, 2) coordination among U.S. Agencies, and (3) coordination and harmonization with other nations and international organizations.

1) Launches to orbit

- a. This category represents the current FAA licensing regime for launches vehicles and re-entry vehicles.

2) In-orbit activities

- a. In general, in-orbit activities are unregulated. However, there are some situations that have required the U.S. Government to develop specific rules. These are spread among a number of agencies and are not well coordinated. Specifically, the Federal Communications Commission requires that geosynchronous satellites at the end of their useful life retain enough fuel to be transported into "graveyard" orbits; enforcement and verification remains problematic. Additionally, the FCC is the agency responsible for representing the U.S. at the International Telecommunications Union meetings and for authorizing the use of spectrum in the United States.

- b. NOAA has a similar requirement for the commercial earth observation satellites under its jurisdiction. Rather than a specific requirement for end-of-life, their regulations require companies to submit a plan for disposal of the satellite that will meet the approval of the Secretary of Commerce.
- c. The FAA OCST has the authority to oversee launches and defines the end of the launch period as the time when the launch vehicle last exercises its control over the payload. Normally, this includes some in-orbit activities. They also have authority for re-entry vehicles to oversee in-orbit preparations for the re-entry.
- d. Finally, IADC Guidelines on Space Debris Mitigation are voluntary rules with no specific enforcement provisions. However, some of the recommended guidelines have become enforceable through enactment of specific legislation and agency regulations in the United States.

Congress has not given authority for any Agency to coordinate or regulate most in-orbit commercial activities. Consideration should now be given to studying in-orbit activities and for the United States to take a leadership role in addressing a number of possible legal problems associated with commercial in-orbit operations. These include addressing:

- i. Liability issues under Treaties that are inadequate and need attention through national legislative initiatives
- ii. Sustainability and debris issues remain unresolved including legal uncertainties with future servicing satellites
- iii. Human safety on private in-orbit vehicles may have conflicting authority
 - 1. NASA ISS transportation for astronauts on commercial vehicles could fall under FAA jurisdiction or be exempt and under NASA regulations
 - 2. Interface with the ISS and international partners will involve not only NASA directives but also those of other nations.
 - 3. Proposals for a "hotel" or private research facility remain open question on regulatory and liability exposure.

Additionally, other nations as well as the United Nations Committee on Peaceful Uses of Outer Space are beginning to address issues of in-orbit regulations mainly through activities on space debris and space sustainability. The United States will need to coordinate its activities with these on-going efforts.

3) *Non-orbital activities:*

(I am suggesting the use of a new term non-orbital, to separate true suborbital flights within airspace from launches of rockets that enter into outer space but have a planned trajectory that returns to Earth without achieving orbit.)

Currently sounding rockets that can reach altitudes as high as 1000km, which is roughly 10 times the distance defined as the "edge of space" are included in the definition of a suborbital trajectory. This is confusing, as the term, sub-orbital, should mean just what it says: below the point where a rocket or payload cannot reach orbital altitude. Since once something reaches outer space there are different rules that may apply due to international treaty agreements. Therefore a separation between non-orbital activities and suborbital activities may clarify a definitional problem, particularly when and if separate in-orbit regulations of commercial spacecraft are issued. An example of a non-orbital commercial activity might be a launch vehicle used for point-to-point delivery of cargo.

4) *Sub-orbital activities*

These should be limited to those non-aircraft activities that stay within airspace (but could cross borders and also fly over the open seas); they should be under FAA jurisdiction and be treated similarly to aircraft. If the market becomes truly commercial, these activities can graduate from the current experimental phase. At that point these activities should be transitioned from OCST licensing to another part of the FAA whether private human passengers are aboard or just cargo is being flown.

5) *Domestic spaceport regulations*

These are currently being licensed by FAA under domestic law.

Accident Investigations

In the Congressionally-mandated 2008 Analysis of Human Space Flight Study we discussed a potential conflict in the delegation of authority for investigating an acci-

dent involving humans in space flight. After the Shuttle *Columbia* accident, Congress passed legislation requiring a Presidential Commission to be formed following certain types of space accidents. (That legislation is now found at Title 51 of the U.S. Code, Chapter 707.)

Those conditions are outlined in §70702, Establishment of Commission. The relevant parts of that section for the issues presently before this Committee are: ... (3) any other United States space vehicle carrying humans that is owned by the Federal Government or *that is being used pursuant to a contract with the Federal Government* or (4) *a crew member or passenger of any space vehicle* described in this subsection.

Clearly, Congress intended that a high profile investigation occur in the event of a space accident. Private launch vehicles and spacecraft, whether licensed by the FAA or not, are within the purview of this law. Furthermore, if humans are on board and are injured, a Commission is also mandated. This section can also be read to include suborbital vehicles (as now defined under OCSST legislation) if they are being used to carry research or other instruments that are under an agreement with a Federal Agency. And these types of commercial services onboard suborbital vehicles are the subject of current agreements and discussions between government agencies and private companies, although they have yet to actually fly.

We also were informed during the 2008 study that the FAA OCSST has a Memorandum of Agreement with the NTSB that in case of an accident with more than \$25,000 property damage and/or injury or death to a human being onboard a vehicle licensed by the FAA, the NTSB will lead an accident investigation. At present, the NTSB has legislative authority to investigate virtually all modes of transport accidents except space. However, in discussions the General Counsel of the NTSB in 2008, he was clear that the NTSB was consulted and did actively participate in the Columbia accident investigation and that there was good cooperation among Federal Agencies.

Therefore, although there may not be any negative or competitive issues regarding the cooperation among Agencies in the case of an accident investigation, **it would be advantageous for Congress to clear up any ambiguities and to clearly designate who will be in charge of a space accident under the specific situations that currently have overlapping jurisdiction.**

Inherent Conflicts Between FAA Role as Promoter and Regulator

A survey of firms involved in developing commercial space flight capabilities done in connection with the 2008 Study found that none of the companies had any issues with the FAA's dual roles of promoter and regulator.

In my testimony in 2003 before this Subcommittee on this issue, I pointed out that there is an inherent possible conflict if the same Agency that is charged with promoting an activity is also in charge of regulating it. The conflicts arise two ways: 1) since regulations cost industry money and possibly market share or profits, there will always be pressure from industry to minimize regulations, and 2) as competing firms with different types of vehicles capable of serving similar markets develop, they will pressure an Agency to favor specific products or types of services with the larger and more powerful firms prevailing.

Elements of these conflicts are present in commercial space, even if today the industry is still too small and too risky for serious issues to arise in regard the Agency's dual role. More specifically, when the role of promotion was given to the FAA's commercial space operations there was only one type of vehicle, the ELV. Today under FAA regulatory authority there are ELVs plus companies developing reusable launch vehicles (RLVs), suborbital commercial vehicles, and unmanned high altitude vehicles (UAV), all of which can compete against each other for air traffic control as well for services in certain markets. For example, future UAVs will need coordination with all launch vehicles in traffic management. But, even more importantly, UAVs will perform services such as regional remote sensing and telecommunications for private end users. These are the very same types of services that companies now provide with LEO satellites and possibly may also provide using suborbital rockets.

Congress should monitor the maturity of the industry. When and if one regulatory Agency or one office within an Agency is burdened with either regulating closely competing transportation services and/or burdened with choices of which transport mode to promote and which to ignore, these functions should be assigned to another Agency or to different offices within an Agency.

ISS Crew Transfer Issues

As mentioned above under in-orbit regulatory activities, recent plans of NASA rely on commercially provided services for transportation to the ISS. Commercial vehicles will do what has been done previously by government owned and operated vehicles or by payments to the Russian Government for Soyuz launches. FAA licenses were not required or involved. But, they clearly could be if NASA's plans materialize.

There are a number of issues to consider before granting licensing authority to the FAA for transporting U.S. Government astronauts or payloads to the ISS. First, NASA already has a complex and well-developed set of safety regulations in place for both human and non-human space flights as well as for approaching and docking with the ISS. What would a new set of regulations add? Would they be less expensive? Would they compromise safety? Since there are no commercial flights to the ISS at present, there is no database to judge the wisdom of changing regulations and/or the regulatory agency.

This then could become a chicken-and-egg problem. NASA will possibly be the prime customer of the first commercial U.S. in-orbit flights with humans on board. It is unlikely that a human-rated private vehicle will be available from any company before the planned ISS flights. Therefore, there will be no database without NASA. The larger question is, given cost and price, whether NASA will pay for what it will demand (that is, safety regulations that are most likely more costly and more comprehensive)? And, if so, will that become the standard for FAA regulations for completely private passenger in-orbit flights as well as NASA in the future, or will the FAA develop a different set of regulations for private flights? Over time, if successful, NASA could use those, but in the near-term it may be a wiser path for Congress to allow NASA to determine the safety standards for its missions.

There is yet another issue with the safety of the ISS itself that involves not only NASA but also its international partners. Each has veto powers in the ISS agreement. Just recently an announcement was in the press that the Russians would not allow a private U.S. vehicle to dock at the ISS. Whether they are concerned about their near monopoly power with the Soyuz flights to the ISS or whether they are truly concerned about safety is immaterial. If they have the right to deny a U.S. vehicle access to (at least) their docking mechanism, then either costs will be greater and/or there will be no market large enough for the commercial U.S. vehicle. In this case the FAA will have no input into the decision, as it is not a direct party to the ISS agreement.

Considering other non-government U.S. in-orbit commercial activity, the FAA clearly should have a role in both safety and financial responsibility. As with launch activities, where the FAA itself does not have the technical competence, they can and should establish agreements with NASA and the DOD to aid in the safety review process. And, as they now do in aircraft certification, they can work with the manufacturers of components to insure the best standards for quality control and safety. At some future point when space vehicles are more standard, the FAA should work toward a certification program that is different technically but similar in process to the one now used for aircraft.

The financial responsibility issue is more difficult for on-orbit activities. The difficulties with the current space treaty liability regime are too numerous and complex to describe in this brief summary. As explained below, the core of the issue is determining how to implement a fault liability regime as described in the Liability Convention.

With the advent of commercial in-orbit vehicles as well as the more traditional satellites and the ever-increasing probability of accidents in space, diplomatic negotiations as required by the Treaty for the first-order settlement of claims may not be successful. If these issues are put before a tribunal, it is likely that nobody will be compensated since there currently are no rules of evidence, no clear definition of what a space object is, no standard of care that is commonly accepted, and no history of prior court decisions. Adding to that is the possibility that debris may create an accident many years ahead. Even with insurance policies for liability on-orbit, the guarantee of a payment to an innocent party is nonexistent. Extending the financial responsibility regulations that now exist for launch vehicles and their component parts to in-orbit activity will require much study, analysis, and creativity. This difficult task will involve many Agencies of the U.S. Government, foreign governments, international entities (e.g. ESA) and the United Nations. The FAA will have an important role in these discussions and in the future regulation of commercial in-orbit activities.

Consent and Waiver for Private Passengers/Participants in Space

In the 2004 Amendments to the CSLA, Congress mandated that private passengers on space flights were required to be informed by the operator of the vehicle of the risks involved and were also required to execute a reciprocal waiver of claims with the FAA. The legislation was quite specific and, among many requirements to be disclosed also included a full disclosure of the accidents that space vehicles of all types have had.

The FAA decided to let the companies develop the consent form rather than to develop a standard one. **It may, at this time, be advantageous for the FAA to draft model clauses for the form with the generic information about all space accidents and other non-company and non-vehicle related clauses that are required.** The FAA is in a better position to collect and distribute uniform, accurate, and full data on those topics. Companies would be responsible for including those clauses as well as drafting the informed consent agreement appropriate to their vehicle and services.

Several States that have or are developing private spaceports have enacted legislation that protects operators (private companies) from being sued by passengers for liability in case of an accident. Florida, Virginia, and most recently, Texas, have different versions of these provisions. I would question whether this trend in competition among the States in the form of protecting companies is beneficial.

First, this type of waiver can provide an incentive for carelessness in safety. The States do exclude gross negligence or willful actions from the waiver of liability. However, safety can be jeopardized in other ways that simply may be financial decisions based on reasonable risk analyses, but ones that are not standard practice in most of today's space vehicles. Companies will argue that safety is paramount since any accident in an infant industry situation will mean serious economic losses to the company. But, that may not be sufficient when dealing with the many unknowns and risks of spaceflight, as we know it today.

Second, launches from non-coastal states will likely fly over adjacent states. Accidents are adjudicated according to the laws of the state where the accident occurs. Contract and tort laws are different in each state. Therefore, there is a question as to whether a consent and waiver form signed under the law of a state where the vehicle originated would be honored in another state where the accident occurred.

In short, **it is time to study this issue more closely and for Congress to make a clear determination of what authority states may have in issuing waivers of passenger liability to the operator of commercial space vehicles.** Federal preemption would be appropriate action to avoid an uncoordinated hodgepodge of different state rules for an activity that is primarily national in character.

Summary of Recommendations:

1. **Experimental permits:** The experimental permit for human suborbital commercial flight should not be permitted to expire. Instead of another arbitrary period of years being designated for the sunset of experimental permits, other tests should be developed to determine when the regulations should be re-evaluated by Congress. I would recommend a panel of appropriate experts be commissioned to study this issue and develop a set of quantifiable tests to evaluate the maturity of this industry segment and to make recommendations based on the development of a mature market and a reliable and safe operating record. At that point these suborbital activities should be transitioned from OCST licensing to another part of the FAA and have a regulatory framework that is technically different but otherwise similar to aircraft, whether private human passengers are aboard or cargo is being flown.
2. **On-orbit Regulations:** Simply extending the safety review and financial requirements of a launch license regime to include in-orbit activities will not be sufficient to solve the complex future issues of liability and sustainable space activities. In addition to in-orbit regulations of satellites, non-orbital activities that enter outer space should also be similarly regulated. Under international treaty obligations they create the same U.S. Government liability exposure as any other in-orbit activities. Congress should recommend that the FAA commission a study to evaluate the complex legal environment of in-orbit liability in order to develop effective and workable U.S. regulations that will clearly provide protections that will not unfairly burden industry or governments.
3. **Accident Investigation:** Congress should clearly designate who will be in charge of investigating a space accident under the specific situations that currently have overlapping jurisdiction.
4. **Informed Consent Waivers:** It may, at this time, be advantageous for the FAA to draft model clauses for the form with generic information about all

space accidents and other non-company and non-vehicle related clauses that are required. Companies would still be responsible for the form and for providing information about any specific vehicle they operate.

5. **State Laws Limiting Operator Liability to Passengers:** Congress should study this issue and make a clear determination of what authority states have in permitting waivers of passenger liability to the operator of commercial space vehicles. Issues of vehicle safety, interstate commerce, and conflicts of laws among the various states raise possible future problems.
6. **Promotion and Regulation in One Agency:** When the OCST was formed it had only one type of vehicle (ELVs) to regulate. It is foreseeable that the OCST could be burdened with regulating closely competing economic activities (e.g. ELVs, RLVs, suborbital vehicles and UAVs all may be using or transporting payloads capable of providing similar telecommunications or remote sensing services to end-users). And, it is also possible that the OCST will be in charge of licensing competing vehicles. Choices of which type of vehicle to promote and which to ignore are as difficult as issues of developing different rules and oversight for different vehicles. If any of these conditions develop into true conflicts, Congress should consider a clear separation of functions among different agencies.

Closing Statement

The future role of the FAA OCST in commercial space will be very important. But it will also require changes from today's regulatory structure. Those changes will reflect the changing commercial space environment. If the projections of some advocates materialize and a vibrant suborbital business is created, then these activities that occur mainly in national airspace might logically be moved to other parts of the FAA that manage domestic airspace and coordinate with ICAO on international matters.

The licensing of in-orbit commercial activities will grow as governments contract with commercial firms for different services. There are many new issues that have domestic and international implications with regulating in-orbit activities. The FAA will be instrumental in shaping these rules for U.S. operations. However, it is unlikely that these services will grow without a large initial market funded by the traditional government space agencies (NASA, DOD, DOC/NOAA) as the prime customers. Commercial firms initially will need to abide by many existing government safety rules. Eventually, after gaining practical experience, these rules may be subject to modification, codification, and implementation by the FAA for licensing of private operations in-orbit. Before the point where these firms have obtained a level of expertise in safety that satisfies the Congress, the operations of government missions in space should remain with the Agencies that have historically demonstrated an excellent overall safety record in a very hazardous and risky environment.

Chairman PALAZZO. Thank you, Dr. Hertzfeld. I thank the panel for their testimony, reminding Members that Committee rules limit questioning to five minutes.

The Chair will at this point open the round of questions. The Chair recognizes himself for five minutes.

Dr. Nield, your budget request appears to be premised in part on the expiration of the eight-year regulatory prohibition at the end of calendar year 2012. In the event that the prohibition lapses, how will AST approach the task of drafting a framework for regulating commercial human spaceflight in the absence of any real experience? And question two, assuming AST desires to put in place a structure that is workable and won't choke the fledgling space tourism marketplace with overly prescriptive regulations, how would AST go about the task of regulating an industry that for all practical purposes doesn't exist yet?

Dr. NIELD. Thank you for that question. Certainly, the development of regulations to ensure the safety of flight crew and spaceflight participants is on our to-do list. That is something we are focused on, thinking about, and talking about, but until the Congressional moratorium is lifted, we would not be in a position to issue any new regulations. However, we do have responsibility

to regulate the operations and safety of the emerging commercial human spaceflight industry as Congress specified in the Commercial Space Launch Amendments Act of 2004 and so we would propose using the tools that we have at our disposal including the issuing of licenses, permits, safety approvals, and conducting safety inspections to ensure that safety.

We also continue to have the responsibility to ensure the safety of the general public on the ground, and so we are in a position today to be responsible for, as I said, 204 licensed launches that have already occurred, so industry is present. What is new now is the emergence of the commercial human spaceflight, and that is really taking two different directions as it goes forward. One, the commercial crew development in support of the NASA space station which is coming in the next years, and the second is the suborbital space tourism activities. So both of those are very important and I think they warrant different approaches, and we are trying to prepare for both pieces of industry's activities.

Chairman PALAZZO. Can you elaborate on the different approaches between the two?

Dr. NIELD. I think inherently the suborbital flights and the orbital flights are different. On the suborbital side, you have an opportunity for incremental step-by-step flight testing, and of course, that is what we saw with the SpaceShipOne winning the X Prize back in 2004 and now we have a number of companies that are designing, building and testing vehicles for that type of an operation, and we expect to see a number of flight tests in the very near future, but those flights will tend to be just 10 to 20 minutes long in the spaceflight portion of it, and they are relatively benign in terms of environmental conditions.

On the orbital side, you can do lots of analysis, you can do lots of ground testing, but once you are ready to go to space, you light the rocket engine and you pretty much need to go all the way to orbit. So that is really a different scenario, and of course, we do have 50 years of experience with NASA conducting those human space flights to orbit that we can draw on in terms of preparing some top-level guidance and safety standards for industry, so we are not really starting with a clean sheet. We would propose working closely with NASA and the industry in preparing the overall guidance.

Chairman PALAZZO. Another question, Dr. Nield. To what level of detail does AST plan to regulate commercial human launch systems seeking a permit or license? For instance, does AST plan to get down to the component level of each system approving their design, operation and maintenance, and will you require several levels of redundancy for each critical system?

Dr. NIELD. I think someday we will end up with a certification process that is very similar to what the FAA does for aviation and so that might well entail going down to the system and subsystem level and components and so forth. That has led to an incredible safety record for aviation. But I think it is too early to try to do that kind of thing for space transportation today, and so our approach has been to have top-level system safety performance-based regulations that do not dictate the particular kinds of designs or particular kinds of operations that are being proposed, but rather

make sure that we have the right kind of end result, which is to ensure the safety of the public on the ground, and to the extent possible to also ensure the safety of those on board.

Chairman PALAZZO. Thank you.

I now recognize the Ranking Member, Mr. Costello.

Dr. COSTELLO. Mr. Chairman, thank you.

Dr. NIELD, we all agree that safety is the number one responsibility of all of us when it comes to this issue. You indicated that the FAA is trying to prepare for putting regulations into place for human space transportation. Can you tell us where you are right now? Where are we as far as planning is concerned?

Dr. NIELD. Just to briefly review, we have had and continue to have regulations in place to protect the safety of those on the ground and so many of the rockets that are being proposed for launching commercial crew have already been flying under FAA licenses. What is new is having the people on board. So we have known this was coming. We have been studying. We have been talking. We have been debating. We have been researching to find the best practices within NASA and the industry on how best to do that. We worked very closely with NASA on their proposed human rating draft requirements that have already been issued, and in fact, we have just announced a public meeting down in Cape Canaveral later on this month that would allow industry and NASA and others to talk to us about the recommendations that they would have on a regulatory approach.

Mr. COSTELLO. In your opinion at this point, what criteria or information do you think the FAA needs to begin to establish regulations?

Dr. NIELD. I think we have the basic information that is needed. We have the 50 years of human spaceflight experience gathered by NASA. We have 50 years of experience that the FAA has in regulating the aviation community and 204 licensed commercial launches. What we really need at this point is good communication and coordination between the parties involved. In order for this industry to be successful, we can't afford to have one set of requirements for NASA missions and one set of requirements for FAA regulations. That would not allow industry to close their business cases and it would be needlessly inefficient, so we need to work together to ensure that we have consistent and compatible requirements.

Mr. COSTELLO. And you mentioned that you are working with NASA now. That relationship, would you tell the Committee that it is working well, you feel that you are working cooperatively?

Dr. NIELD. I think we have made good strides there. Frankly, our 2012 budget request has a key enabler for that cooperation, and that is the Commercial Space Flight Technical Center at Kennedy Space Center (KSC). We view that as an excellent opportunity, not only to potentially hire some of the experienced workforce that are going to be searching for work in the months ahead, but also to be basically collocated with NASA to build that cadre of subject-matter experts on engineering standards and launch operations.

Mr. COSTELLO. As you know, the FAA reauthorization that passed the House has an extension of the prohibition on regulations and would extend for eight years after the first licensed

launch of a spaceflight participant. I understand that may move the prohibition to maybe the year 2020 and that the FAA may have some concerns with that. Can you express the concerns that the FAA may have?

Dr. NIELD. Yes. I very much understand the intent of the original moratorium, which was the fear that the government could stifle industry and prevent it from doing creative and original experimentation to really get its feet on the ground, and although there have not been commercial human space flights since 2004, I think our office's dual mandate of ensuring public safety and to encourage, facilitate and promote the industry gives us a unique perspective to be able to recognize that the only way to be truly safe is not to fly at all. So we understand the delicate balance there and we would propose to have the option to be able to take advantage of trends, of best practices, of lessons learned, of anomalies during flight tests. If something should start to appear as an indicator of problems, which was talked about by Dr. Dillingham, then we want to be able to move quickly to be able to allow all to take advantage of those lessons learned rather than potentially having future accidents. So we are not ready to burden the industry today. We just want to focus on safety and try to allow experimentation and creativity as we go forward in a safe manner.

Mr. COSTELLO. Dr. Dillingham, would you comment on the prohibition, the extension?

Dr. DILLINGHAM. Yes, Mr. Costello. I think we are pretty much in line across the panel with regard to the extension of the prohibition. It is not clear to us at the GAO what is the basis of the eight years. We would be in the line of sort of incrementally looking at what is going on at that point and moving as you get more information, but the caution that we make with regard to sort of the eight years, be careful about making regulations in times of crisis. That is, if the industry, if there is an accident and all of a sudden we are trying to make regulations, sometimes it doesn't quite work out the way that the Congress wants it to work out when they don't have the time to deliberate, and FAA in the same way. So we are for incrementalism. We don't see any basis for eight years.

Mr. ROHRABACHER. [Presiding] You have a new Chairman here now. We have a vote on right now, and we will continue this discussion after the vote, and I would expect that would be in about 15 or 20 minutes, so if we could recess here. The Subcommittee is recessed for 20 minutes.

[Recess.]

Mr. ROHRABACHER. The Subcommittee on Space and Aeronautics will come to order. I want to thank the witnesses for sticking around while we had to do our business on the Floor, and Mr. Costello, the Ranking Member, has had his options, and are we going to give the Chair back? Well, we will now proceed for questions for our panel, and Mr. Brooks from Alabama, we will proceed with your time.

Mr. BROOKS. Thank you, Mr. Chairman, and Mr. Chairman. We have got two of them right now.

You know, we are facing a \$1.6 trillion deficit which I would submit to you is a very serious threat to our country, it could result in a Federal Government insolvency or bankruptcy if we don't get

it addressed, and I see where you are asking for a 75 percent, or AST is asking for a 75 percent funding increase. Then also look at the word "commercial," and when I see the word "commercial," I see little or no government involvement, not substantial or significant government involvement. To me, commercial means free enterprise and private sector as opposed to something that the government has a heavy hand of managing or subsidizing. I also see commercial as meaning that there is a profit motive and that is the reason for the commercial activity is that there is a way that someone in the private sector can do something faster or cheaper or better than perhaps the government or its competitors and hence they can make a profit because they are able to do that better or faster or cheaper.

Now, of this \$15 million that was budgeted in 2010 and \$27 million that is requested in fiscal year 2012, Dr. Nield, can you tell how much of this is paid for by the commercial space entities via either license fees or taxes or some other source of revenue?

Dr. NIELD. None of it, because under current law, we are not allowed to charge for licenses that we issue.

Mr. BROOKS. Well, you have often used the FAA as an analogy with commercial flight, and correct me if I am wrong, but isn't the FAA's budget significantly paid for through ticket taxes, landing fees, fuel taxes and things of that nature?

Dr. NIELD. That is a significant component of overall FAA expenditures and so as the industry develops, I think it certainly is appropriate to think about whether similar ideas can be incorporated for space transportation. The problem is with a relatively low number of launches taking place, then if you try to cover the cost per ticket, per passenger, for rocket, that ends up putting additional burdens on the industry, which is going to have a negative impact on the U.S. efforts.

Mr. BROOKS. Well, that kind of brings us to another question that I had. With respect to the low number of launches, why is it that we have that low number?

Dr. NIELD. There is a variety of different reasons for that. I think in recent years, the United States has not been competitive with the rockets that are offered by other countries. In other countries, the space programs tend to be very much part of the government efforts. I think the United States is rather unique in that we do have a commercial industry. In recent years, DOD and NASA contracts with industry have perhaps caused the U.S. efforts to not be as competitive as we would like to see them, but I think recently there has been some new entrants to the industry, some new ideas, some new entrepreneurial spirit, and we are seeing some of the prices come down, and I think that is going to lead to the U.S. market share eventually growing back to where we would like to see that in the future.

Mr. BROOKS. If I recall correctly, AST was created sometime around 1984. Is that—

Dr. NIELD. That is correct.

Mr. BROOKS. So it has been in existence for more than a quarter of a century, and commercial launches appear to be on the decline rather than the increase. Might that be because at least as of now, there is little to no commercial viability?

Dr. NIELD. I would disagree with that assessment. I think the progress of the industry has been slower than people would have liked to see, but as we look at what we are seeing now in terms of research, development, plans, contracts, customers, there is a lot bubbling out in the world right now and I think we are about to see a rapid increase in a variety of different parts of the industry, whether it is space tourism or commercial involvement to allow NASA to get lower cost transportation to low Earth orbit so that it can concentrate on exploration and a variety of different other programs.

Mr. BROOKS. Is there an impact on the commercial viability of these private ventures caused by the regulatory atmosphere of AST? Stated differently, are the AST regulations increasing the cost of being commercially viable which in turn means they are less commercially viable or not commercially viable, which means that they don't do it?

Dr. NIELD. I would state that we are not a cause of that. I think it would be important for the Committee to talk to industry to get their impressions, but I believe that the regulations that we have in place are very much focused on safety while allowing industry to take the steps that are appropriate to have viable businesses.

Mr. BROOKS. Thank you. As you may know, I am just a lowly freshman on this panel trying to learn the ropes. This is my first exposure to this particular issue, and I very much appreciate your candor, and I yield the remainder of my time.

Mr. PALAZZO. I now recognize Mrs. Edwards from Maryland.

Ms. EDWARDS. Thank you, Mr. Chairman, and thank you to our witnesses today. This is an issue that I have had a longstanding interest in. I am trying to understand what the role and responsibility of the commercial sector is with respect to the commercial space industry and how that relates also to the responsibilities that we have as a government and that our agencies, particularly NASA, FAA and others have, so I appreciate your testimony. And I, like others, want to express that I share the hope that this is just the first of a series of hearings that we hold on commercial space transportation because there are a number of issues that I think it is important to address and understand well prior to a robust industry being developed. We have to understand the implications of having the FAA as both the regulator of commercial space transportation safety and the promoter of the industry it is regulating. As we know, FAA used to have that dual responsibility for the commercial airline industry until Congress withdrew the FAA role for both promoting the industry and regulating the industry because of a perceived conflict of interest and so that the agency could focus on safety. I think we have some very similar concerns right now, and rather than waiting until the point where we know there is a problem and have to withdraw the authority, we should deal with that at the outset.

I think as well as NASA moves forward to work more closely with the private sector, these issues of safety, regulatory authority, and liability in commercial space will need to be addressed rigorously to ensure the safety of the public and individuals in space or near space as well as those of us who are on the ground. So Mr.

Chairman, I appreciate your holding the hearing today because I think it is an important and timely topic.

I have just a couple of questions, and probably will have some additional ones for the record. I am particularly concerned about this question of indemnification and liability, because unlike when NASA launches even with commercial payloads or purely government payloads and personnel, there is a deep, close relationship there, and I can envision an environment where you would have, say, a tourist on board. It is not like an astronaut where an astronaut might have specific technical expertise and responsibilities, has been engaged in the program all along and understands the vehicle and those sorts of things. If I go into space, and I might want to be one of those if I win the lottery and can afford a ticket, I hope that nobody gives me any technical responsibility on the vehicle. I just want to be there, but I want to get up, get back and be safe. So it is difficult also to imagine who the private insurer is out there who will indemnify me as a tourist, and I don't want that to be the responsibility of the American taxpayer because some of us can afford to go into space and think that would be a great vacation. So I wonder if you could speak about the indemnification responsibilities, liability, where that falls on the private sector versus on the government, not on the taxpayer.

Dr. NIELD. Yes. Thank you. That is an excellent question. Congress in the Commercial Space Launch Amendments Act of 2004 went on the record and said spaceflight is inherently risky and they told the FAA how we should handle the carrying of people on-board rockets, and that is using an approach known as informed consent, so these operators are going to have to thoroughly brief those ticket buyers on all the things that could go wrong, all the possible risks and hazards, and if they understand that and they are still willing to go, they would have to sign the paperwork and then be allowed to participate. So it is very different from stepping on an airliner with the expectation that you are going to arrive safely at your destinations.

In terms of the overall risk sharing and liability system that we have in place today, there is a three-tier system. The FAA assesses the possible risks and things that could go wrong during a flight, and we come up with a number known as the MPL, the maximum probable loss, and we use that to establish how much insurance a launch operator has to go buy, and that will be up to the level of the MPL, or \$500 million, whichever is less. The second tier then is what has come to be known as indemnification and so the Secretary could ask the Congress to appropriate funds up to \$1.5 billion above that amount. If it is a really, really bad day and the damages are greater than that amount, then the liability reverts to the operator. So all of that is talking about third-party damages. Right now, we have no intention of having the taxpayer subsidize any claims or complaints or injuries for those who fly on these vehicles.

Ms. EDWARDS. Thank you, and with that I yield. I just would say that there is where I will become a real fiscal hawk coming out of this pretty liberal Democrat, because there is no way the taxpayer should run that kind of risk with a purely private program. Thank you.

Chairman PALAZZO. I now recognize Ms. Adams from Florida.

Mrs. ADAMS. Thank you, Mr. Chair, and I want to thank the panel for being here today.

Mr. Chairman, I am very concerned about the budget which has been proposed by AST in fiscal year 2012. I would like to specifically address Dr. Nield first and then other witnesses if I have time. But Dr. Nield, in your testimony, you state AST is responsible for the safe operation of commercial companies and promotion of a robust commercial human spaceflight industry. However, in your testimony you reference regulating space industry or the development of new regulations 11 times. You mention six times the eventual or planned possibilities for robust commercial market without any basis for this development in the next few years and never once mention jobs or free market solutions or economic development. This is kind of troubling to me. The AST is asking for a 74 percent increase in its budget over the 2010 enacted level because it wants to prepare and implement regulations for an industry that in the last 20 years has only required 204 instances of regulatory intervention through some kind of license in the last 20 years. Last year, AST oversaw four commercial orbital launches and no suborbital flights, and yet in your testimony, Dr. Nield, you said AST expects six license and permit applications, 40 launch or reentry operation inspections, eight launch site inspections, five environmental assessments plus new rulemaking procedures.

My concern is the Administration is asking this Committee to believe that after an eight-year moratorium on regulation and an extension of the moratorium in the wings, your office is going to require an expansion of government regulations, spending and staff which to me just defies logic and good sense.

I have a couple of quick questions. In your testimony, you say, "The high cost of access to space has long been a major obstacle for civil, military, and commercial space programs. The dream of low-cost fully reusable space launch systems has recently been demonstrated by the X-Prize competitions but only to suborbital space." Do you believe the dream of low-cost access to space will be closer within your grasp, or our grasp, with a 74 percent increase in your regulatory agency's budget?

Dr. NIELD. If we spend it correctly, I believe it will, and certainly some of the programs that we have proposed including the incentive program, the Center of Excellence, and a number of other activities are designed to enable commercial industry to be successful, which is our hope and objective.

Mrs. ADAMS. So you believe the expansion of regulatory authority is the best way to encourage the development of commercial space?

Dr. NIELD. By itself, regulations have the potential to shut down the industry and that is not our objective. At the same time, in order for industry to be successful, it is helpful to have a common set of well-understood standards that all can follow so that we would—

Mrs. ADAMS. And which would take a 74 percent increase of your budget.

Dr. NIELD. I think if we look at the particular proposals which include incentive programs and the Commercial Space Flight Tech-

nical Center, those are the kinds of things that would be helpful to the industry to allow them to be successful in the future.

Mrs. ADAMS. Do you have any concern that the development of evolution and growth of a regulatory regime based on very little data or information on what to expect from vehicle design or human rating standards encourages a market environment of stability that an investor would want to take on?

Dr. NIELD. I have had a number of discussions with industry leaders, and that is exactly what they are asking for. They are very fearful that we will end up with separate and conflicting requirements from NASA, with its programs for the space station and other activities, and the FAA as the designated regulator for this industry, and they want to ensure that we have a consistent and compatible set of requirements and so that is why it is so important for us to work closely with NASA to take advantage of that 50 years of human spaceflight experience, which is a long time.

Mrs. ADAMS. I will get one last question hopefully. On April 28, 2011, AST published a notice on its website that it will hold a public meeting late this month in Florida to seek input from the affected community. Are you expecting to issue your first round of regulations on December 24, 2012, if the eight-year moratorium expires?

Dr. NIELD. No, we are not.

Mrs. ADAMS. I yield back the rest of my time.

Chairman PALAZZO. Thank you. We will now recognize Mr. Wu from Oregon.

Mr. WU. Thank you very much, Mr. Chairman.

Dr. Nield, I had a set of questions about commercialization and other issues which I think need to be answered, and I am now going to give those questions to Committee staff and have them submit them to you and ask for responses in writing because your answer to a prior question, I thought would have elicited a gasp from this audience, which is basically that when we commercialize, people should not have an expectation of safety, that it is very different from getting aboard an airliner, and that we should have informed consent, sign a disclosure form and then you board the booster and vehicle and then you take your chances. Now, I am just stunned. I am absolutely stunned about that characterization of the future of commercial human spaceflight.

Now, Dr. Nield, there are a couple of consequences from this picture that you painted, and one is that any launch failure which hurts people or kills people, there are immense consequences in addition to killing people, which is something that we should strive with every energy to avoid. It would also potentially flatten the space program for a period of years just as it did after fatal events in the space shuttle and prior. Isn't that a likely consequence and that is the risk that we are taking in the scenario that you paint?

Dr. NIELD. That is a very important risk and that is why it is so important that we have good safety processes in place. That is why we have the regulations that we do, and on the commercial side, that is why they have the need to pay attention to safety as well because not only are they potentially losing their mission, their rocket, the people on board but that has the potential to wipe

out that business if there is a serious accident. So I think they are focused correctly on doing things safely.

In terms of the informed consent process, that is the direction that the Congress has given us and so we are following that to the best of our ability. In the future——

Mr. WU. Okay. I just want to set aside the commercial satellite side of this and focus on the potential for commercial human flight, and we basically treat human spaceflight very differently, and I am just very concerned that any fatalities would cause a dramatic pause in U.S. human spaceflight activity to the detriment of our national interests, and apparently you are saying that we can't prevent that currently.

Dr. NIELD. Our office will do anything we can to ensure safe operations going forward. However, with all due respect, I would point out that all forms of transportation have accidents, have fatalities, whether it is in cars, airplanes, boats and trains, and so the Nation needs to understand that that is part of the risk of exploring the unknown, of doing new things, and we should anticipate that, try to prevent it where we can but not let deter us from moving forward and advancing technology so that the United States can remain as a leader in spaceflight.

Mr. WU. And that is my goal, to have the United States remain a leader, and I am concerned that fatalities will undermine our ability to do that because, you know, a pause happened after Challenger and Columbia, which were federal projects, and that was bad enough. I suspect that with a private venture, the effects would be even more dire.

Let me pull you to a slightly different issue, because I think the loss of life and the loss of leadership in space are the most important ones, but if there is an accident like that in a private venture, we are talking about public indemnity, taxpayer indemnity for damages whereas when it is a federal venture, in essence the government is self-insured. So we are taking on an extra cost, are we not, when we put the risk in a commercial space venture for human spaceflight?

Dr. NIELD. On the contrary, I would say that under the current liability risk-sharing scheme which I mentioned a few minutes ago, there is a requirement in order to get the FAA license to purchase insurance from these commercial entities and so to that extent, it is a better deal for the taxpayer than an all-government program which uses all taxpayer money.

Mr. WU. Wasn't the thrust of Congresswoman Edwards' question that there would have to be some kind of liability cap and that the Federal Government assumed risk beyond that?

Dr. NIELD. The current law involves this three-tier system but the basic first tier is composed of insurance that the companies are required to buy by FAA regulations.

Mr. WU. Yes, but that is the point, that there are additional tiers beyond that.

Dr. NIELD. That is true.

Mr. WU. And private entities are not going to assume all of the risk but the potential high cost.

Dr. NIELD. That is an important factor, and we need to look at how competitive the U.S. endeavors are compared to other coun-

tries that do not have different tiers. I would point out that in the 25 years of operation, not a dime of taxpayer dollars has ever been used. We have never had to exercise that liability risk-sharing scheme, but it is very important to have that in place in order to give some certainty to the businesses that their liability is capped.

Mr. WU. Yes, but you are proposing changes both on the commercial satellite side and human spaceflight, so the risk profile is changing.

Dr. NIELD. Pardon me if I gave that impression. I am not proposing any changes to the liability.

Mr. WU. I mean the flight profiles and the numbers and the missions.

Dr. NIELD. We hope to see lots of launches, and that is going to help insurers to get confidence in the business if we do it well, and that could be a win-win for all, but I am not proposing any changes to the liability regimes.

Mr. WU. Thank you, Mr. Chairman, for permitting me to go a little bit beyond my time, but I may come back to this line of questioning. Thank you.

Chairman PALAZZO. Thank you. Now we recognize Mr. Rohrabacher from California.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman, and let me associate myself with the questions of Mrs. Adams, who I think was trying to get to a very important heart of the issue of today's discussion. However, for my friend Mr. Wu, the Congress specifically voted on informed consent and limited liability. I know, I am the author of the amendment. I was told not to bring it to the Floor, it wouldn't pass. We brought it to the Floor. It passed by a vote of the Congress and then went on to be voted by the Senate. So I think that might have been before you were here, however, but it was when I was Chairman of this Committee—Subcommittee, that is.

So informed consent is part of it, and it may or may not be a policy that you want to continue past a certain time period after our technology and after this new type of transportation system has been developed. Let us just note that we have had certain other industries that have benefited by this type of approach, by limiting liability. We do know that it has been long recognized that overcoming gravity is not the most serious obstacle that has to be overcome. Quite often, overcoming the power of trial lawyers is at least as equal a challenge, and not necessarily overcoming gravity may be much more beneficial to mankind in establishing that capability rather than just overcoming trial lawyers.

With that said, about expanding your budget, let me just note, they say idle hands are the devil's tool, and idle government regulators looking for something to do could actually be of greater concern than being idle hands in the private sector. If we are not going to be increasing the regulatory scope of your operation and actually the situation, this prohibition is extended, why do you need a bigger budget? I mean, aren't we just calling for what Mrs. Adams was pointing to? We now are bringing on a bigger staff but your responsibilities if we do which I think we should, which is continue this prohibition, that really your responsibilities haven't been expanded.

Dr. NIELD. I would beg to differ. I think the responsibilities potentially are increasing as the industry is increasing, and we would like to be prepared to do what we can to enable the successful growth. And so if you look at where we were in past years in terms of the small number of launches and where we expect to be in 2012, I expect again a tenfold increase in the number of launches. We need to follow through on those license applications, do the evaluations, make sure they are safe, process those. We need to have our safety inspectors to make sure we are doing all we can to ensure safe and successful operations. We have also tried to come up with some other ideas including the Commercial Space Flight Technical Center and the prize and other ideas that would hold out some incentives.

Mr. ROHRABACHER. Well, let me put it this way. At a time when we have a trillion and a half dollar deficit and we are trying to find ways of cutting across the board, it might be beneficial to try to see if we can use the staffs that we already have and the budgets that we already have by giving people more responsibilities and thus maybe getting more productivity out of our offices.

Let me just note that if we have a variety of spacecraft to choose from rather than just one governmental system, which some people seem to be pushing to have—NASA has got to be in charge, we have to have the NASA alternative. Well, if we just have the NASA alternative as compared to three or four commercial activities, once there is an accident, we are shut down, as we saw with the space shuttle. Instead, if we have various alternatives in the private sector, there is a big benefit to being able to ease over to another alternative rather than just putting it all on the government's shoulders no matter what the liability question is there. There is a major societal benefit to having these alternatives.

Let me go to Mr. Hertzfeld. You state in your report that without sufficient data, defining a minimum set of criteria for human spaceflight services, because we are already—let me make this very clear. We can already regulate for safety of the people on the ground, and that is already a regulatory power of this office. What we are really talking about is expanding the ability of people to go without the regulation and the massive expansion of regulation on the passengers who we believe can decide for themselves whether they want to step onto a spacecraft, which is of course the informed consent which Mr. Wu was talking about. But if you continue this where people have that choice and thus we don't have to have further regulation, do we see this expansion of power that we are talking about as a necessity for expanding the role of this office?

Dr. HERTZFELD. I think the answer really eludes us today because this industry is changing rapidly, and I see it as a process looking to the future. I was suggesting that we study different types of industry indicators such as the structure of the industry, the maturity, how many passengers, and how many flights are really going to happen. We have had a lot of promises in the past. They are slow to materialize. I do believe someday they will but I don't know when that day is. And there are a lot of regulatory issues that we can't get around. We have air traffic control issues, if we really go to outer space, we have treaty issues where the government has committed to pay if there is a—

Mr. ROHRABACHER. Well, if this eight-year regulatory prohibition does not expire, what burden would that add to the public and the industry that you see?

Dr. HERTZFELD. It really depends on what the FAA is prepared to do when it does expire. I don't think they have been specific yet. If I remember the legislation correctly, and please correct me if I am wrong, that it only gives them the option of looking at regulations when it expires. It doesn't necessarily mean they are going to have to, and that is why I am suggesting we develop a process, we develop a way of approaching it so that if it is necessary, they can.

Mr. ROHRABACHER. And if we don't have any experience at that moment with taking passengers up in a commercial way, how are we going to then put in place regulations when we don't even have the operation happening yet because we don't have a significant number of passengers. And by the way, Mr. Wu, it seems that you did vote for that amendment when I brought it to the Floor back in 2004.

Mr. WU. I see the wisdom of my colleague.

Mr. ROHRABACHER. I yield back my time. Thank you.

Chairman PALAZZO. All right. Thank you. Mr. Wu would like the opportunity to have one more question. If the other Members are so inclined, they will have an opportunity to ask one more question as well.

Mr. WU. Thank you very much, Mr. Chairman.

This is a topic which has been brought up repeatedly in the commercial airline context where the FAA has responsibility for both regulating the airlines as well as promoting commercial airline flight, airline travel. The same apparently applies in commercial spaceflight, and Dr. Hertzfeld and Dr. Dillingham, I would like each of you to comment on this regime and the potential for conflict and whether this is a good arrangement or whether as has been proposed on a the commercial airline side that these functions ought to be separated.

Dr. DILLINGHAM. Thank you, Mr. Wu. Where we are now, when we looked at this issue, this potential conflict of interest, we did not see any at that point in time. We looked at it a few years ago. It does not mean that this situation will not change as the industry matures. One of our concerns is that we not wait until there is a situation where we have this crisis, and it would be like the Air Tran accident. All of a sudden we realized that maybe this is not the way it should be. So our position is, it is fine now. As the industry matures, we think that that separation of promotion and safety should be looked at real close and maybe Commerce would be the place for the promotion aspect of it.

Dr. HERTZFELD. Back in the late 1980s, early 1990s when the FAA really began to gear up, they were only regulating expendable launch vehicles, and so there didn't seem to be much of any potential conflict between promotion and regulation at that time. Today, from everything I have seen, we hear no criticism from industry about this dual role, and I think that would be a measure when we begin to hear complaints, and as I mentioned in the testimony—

Mr. WU. You mean complaints about the regulatory side?

Dr. HERTZFELD. No—well, the regulatory—when you regulate, you are going to cost industry some money, and many regulations are necessary in this very risky business. It is a question of how much and the balance and whether the same agency can successfully promote, which means trying to expand industry, while at the same time other parts of the same office are going to regulate and put possible burdens on the industry. So it is a balance between a social good and competition. Commerce traditionally has had the promotion of industry as one of its major mandates, but also, Commerce has the National Technical Information Service (NTIS) and it has regulations for NOAA. It is not regulatory authority as well. I understand that the FAA has agreements with the space part of NOAA in Commerce but—and so there are already some building blocks of spreading the promotion of the industry among other agencies, and I think at a point where you may be faced with this delicate balance, then the Congress might have to look into the problem. Today, none of us, I think, have seen any indications that there is a conflict there.

Mr. WU. Thank you very much, Dr. Hertzfeld. Dr. Dillingham, thank you.

Chairman PALAZZO. Thank you, Mr. Wu. Ms. Adams from Florida has indicated she would like to have a question. You are now recognized.

Mrs. ADAMS. Thank you, Mr. Chair.

Dr. NIELD, do you believe that the design and operation of private spaceflight capabilities have occurred? Do you believe they exist today?

Dr. NIELD. Yes, I do.

Mrs. ADAMS. So you believe that you know for a fact what the design is going to be and therefore you are able to regulate that design?

Dr. NIELD. In our regulatory approach, we try not to be prescriptive and so we don't specify what kinds of design of hardware or operations that an operator may choose. We try to be performance based so again we are protecting the public.

Mrs. ADAMS. So you believe that the design for performance is created and therefore you can regulate it?

Dr. NIELD. On a top-level system safety basis, I would say the answer is yes.

Mrs. ADAMS. Okay. And that is how you are estimating how much money it will cost to regulate this by your budget. How long did the process of issuing the first reentry license take from application to issuance?

Dr. NIELD. Under the law, we are given 180 days to conduct an evaluation of a complete application package, either for launch or reentry, and—

Mrs. ADAMS. Well, the question was very simple. How long did it take?

Dr. NIELD. It was about two weeks from receiving the complete package until we were able to make a decision. Now, that is an iterative process. We received the—

Mrs. ADAMS. So my information that it took somewhere around a year is incorrect, from the time it was applied until the time it was issued? You are telling me it is two weeks?

Dr. NIELD. It was about two weeks from a complete application until a decision, yes.

Mrs. ADAMS. That is not what I asked you. Issuance.

Dr. NIELD. Someone can submit a cover letter and say we are going to apply for a reentry license but that doesn't meet the intent of the regulations, so it can drag on until all of the information—

Mrs. ADAMS. Dr. Nield, if you don't want to answer, that is fine. When I ask you a specific question, I think I should at least get a specific answer. We will move on.

Dr. Dillingham, GAO reports there will be a 45 percent increase in staffing. Do you believe there is enough certainty in the demand on FAA to require such a dramatic increase in their staff?

Dr. DILLINGHAM. No, ma'am.

Mrs. ADAMS. Does GAO agree with the assertion by AST they will need the type of dramatic increases in funding they are requesting for fiscal year 2012?

Dr. DILLINGHAM. No, ma'am.

Mrs. ADAMS. There are currently eight licensed spaceports, according to your testimony. There is not activity at all of them. How many spaceports currently have routine flights from them?

Dr. DILLINGHAM. I don't think there are any spaceports that have routine flights from them.

Mrs. ADAMS. That is what I was hearing. Do you believe the billions in tax incentives, direct investments and grants at the state and federal level for commercialization has yielded the type of fast-paced growth originally envisioned?

Dr. DILLINGHAM. No, ma'am.

Mrs. ADAMS. Does the increased activity GAO would expect in the next two years for suborbital flights justify a 45 percent increase in staff and a 74 percent increase in the AST budget?

Dr. DILLINGHAM. No, ma'am. We have argued that may be incrementally based on the development of the industry, one could start making that move in that direction rather than the big bang theory.

Mrs. ADAMS. Thank you. And under your understanding of the current regulatory regime, does FAA have the authority to regulate a commercial rocket launch with NASA astronauts going to station if NASA has contracted with a commercial company for the seats?

Dr. DILLINGHAM. I do not know the answer to that but I can get the answer back to you. Maybe Dr. Nield may help.

Mrs. ADAMS. Dr. Nield, would you like to take a shot at that?

Dr. NIELD. Ma'am, it would depend on how the services were procured. If NASA is conducting the launch, no license is required. If NASA is having industry conduct the launch, then a license would be required under the law.

Mrs. ADAMS. What about if the commercial rocket is carrying a payload to the station?

Dr. NIELD. That would not be a determining factor. And again, we are working with NASA to ensure that their needs and FAA public safety needs can be met and have a successful outcome of these types of activities.

Mrs. ADAMS. Dr. Nield, you have heard the discussion here and you can see where I am going. 74 percent increase in a time where economic restraint should be held. You are asking for us to in-

crease your budget for what if. I have grave concerns about that. I just want you to know that.

Chairman PALAZZO. Thank you. I now recognize Mr. Brooks from Alabama.

Mr. BROOKS. It seems to me that the real key to whether we are going to have a private sector or a commercial venture in America that is successful is dependent on whether the businesses that are exploring this can make a profit. Short of subsidies by the Federal Government—and this is a question I would like for each of you to consider. Short of subsidies by the Federal Government, what can Congress do to reduce regulatory or other costs of commercial space ventures in order to enhance the prospect of profitability which in turn would enhance the ability of the private sector to compete in space?

Dr. NIELD. First of all, I think having an enlightened but responsible regulator would ensure that the industry can be successful, and that is what we aim to be. Other things would include ensuring that the liability structure that is set up is appropriate to allow the businesses to compete internationally. Certainly, research is an important area to the extent that we can provide the tools that the companies need to have the latest rockets and engineering operations. That would be very important. And I think through the use of contests and prizes, the government can have a leverage effect on its investment without paying out taxpayer dollars until or unless the requirements of the prize have been met. Historically, that has been a very successful incentive for industry investment. So those are some of the things that come to mind, sir.

Dr. DILLINGHAM. I would think that the current regime that is in place now where regulation is in fact sort of balanced with the development of the industry has been one of the major contributing factors to the industry moving as it has up to this point. It is not as fast as one might want it to be, but anything that does not tamp down the idea of profit for the industry will be helpful, I believe.

Mr. BROOKS. Do you have any specifics?

Dr. DILLINGHAM. No, sir, not now, but I can in fact get back to you with some specifics.

Dr. HERTZFELD. I think all the things that Dr. Nield mentioned will help, more research and more balanced approach and all the rest, but I think we have to keep in mind that for the near-term future, maybe for longer and in the history, this is a dual use. Space is dual use. We have had private companies involved for many, many years, mainly as contractors as opposed to selling services to the government, but the government depends on all of the private companies and always has. This is a slight change in what we see in terms of some of the private developments and the entrepreneurial efforts, but the government's research is really what has stimulated space and probably the government services will for quite a while, and what is happening in the commercial sector is interesting. It may take time, but I think that our core dependence on the space capabilities will remain as the primary stimulus for technology changes and through technology changes primarily for cost reductions. I don't believe the regulatory burden is so expensive compared to the technologies in getting to space that making regulation a little less expensive is going to make a

big difference in the price or supply and demand for space as we move along.

Mr. BROOKS. Thank you. If there is anything specific that comes to mind in the future of what we can do to help our commercial space industry be more competitive, cheaper to operate, more profitable, particularly in the face of international competition, I would welcome that communication to my office.

Dr. NIELD. Mr. Brooks, if you would permit me?

Mr. BROOKS. Please.

Dr. NIELD. One idea built on what Dr. Hertzfeld said is very important, and I think that the effort that NASA has recently employed to purchase services rather than build its own rockets to operate could be a huge incentive to our industry by having companies design their own systems to provide cargo to the space station and some day to transport astronauts. I think that could be a real enabler to the success of the industry in the long term that NASA can take advantage of and that will allow the United States to be competitive in this area internationally.

Mr. BROOKS. Is the private sector now less expensive in delivering payloads to space than NASA?

Dr. NIELD. Absolutely.

Mr. BROOKS. We have got the satellites. How about man?

Dr. NIELD. We have had only limited commercial human spaceflight, a few flights by SpaceShipOne, but I think in the future as industry starts to offer that option too, then I believe it will end up costing less than a government program as well, and that remains to be seen but I think that is the promise of enabling our industry.

Mr. BROOKS. Thank you.

Chairman PALAZZO. I recognize Mr. Rohrabacher from California for our final series of questions.

Mr. ROHRBACHER. Thank you very much, and let me just note that whatever money is invested by these private companies and whatever systems we have available to us then without having to worry about budget interrogations as you have gone through today because we always take it for granted that a private company is trying its very best to be as productive and keeping those budgets down as much as they can because there is that dynamic that doesn't exist in the Federal Government because government doesn't have the same dynamic as the private sector. And then also if one system goes down, we have other alternatives to choose from, as I say, compared to the shuttle where we put all our eggs in the shuttle basket and it really put us in jeopardy after those accidents.

Commercial space companies—let me know, Mr. Chairman—I believe are on the edge, the cutting edge of human progress. We now have a gang of industrialists, inventors, explorers, entrepreneurs and yes, adventurers who are pushing the envelope, and this is very American and this is what we are supposed to be all about. They are going into the new frontier and they are utilizing it and taming it and finding ways of how we can utilize the great resources that are on the frontier. I would suggest that the area between the moon and the Earth will become a commercial enterprise zone basically being utilized by commercial enterprises and that

NASA in the future will be looking to further exploration and the moon and beyond and developing new technologies. We have reached—your point about well, developing the technology, that is really where the cost is as compared to regulatory cost, well, that is true, but we have reached the plateau on the development of technologies now that will permit commercial enterprise and those technologies are there and the cost has already been paid, so I would say at this point the regulatory burden is what is probably the greatest threat in holding us back from utilizing that space between the Earth and the moon for the benefit of humankind.

This is very similar to the time period during the last half of the last century when aviation was developed in 1903, the first plane that went off, and at a certain point it became possible through contracts, mail contracts, through war contracts, dual use with military and civilian use, civilian airlines became profitable, they became a potential. We are at that point right now with commercial space, and let me congratulate the Obama Administration, which you will rarely hear from me, and they have managed to see this where some of my own colleagues on the Republican side who always talk about enterprise and keeping costs down and making profit ventures don't seem to have grasped what this Administration has grasped, and that is, the more money that is invested in the private sector and the more potential profit we are making for these entrepreneurs, that means there will be more money for NASA and other people to do their job and expand the potential of human activity in space.

So Mr. Chairman, thank you very much for a very important hearing and I am looking forward in the days ahead to working with you to make sure America reaches its potential both with NASA and in the commercial area. Thank you very much.

Chairman PALAZZO. Thank you, Mr. Rohrabacher, and thank you for stepping in for me while I had to go to another Committee to cast a vote.

I thank the witnesses for their valuable testimony and the Members for their questions. The Members of the Subcommittee may have additional questions for the witnesses, and we will ask you to respond to those in writing. The record will remain open for two weeks for additional comments from Members.

The witnesses are excused and this hearing is adjourned. Thank you.

[Whereupon, at 12:05 p.m., the Subcommittee was adjourned.]

Appendix

ANSWERS TO POST-HEARING QUESTIONS

ANSWERS TO POST-HEARING QUESTIONS

*Responses by Dr. George C. Nield, Associate Administrator
for Commercial Space Transportation, Federal Aviation Administration*

Questions submitted by Chairman Steven Palazzo

Q1. You testified during the hearing that, "... in the coming months, it may be necessary to revisit some of the statutes and regulations that govern commercial space launch activities. Specifically, the FAA's legislative authority may require revision so that we can continue to ensure public safety both in space and on the ground. We see the potential for greater regulatory authority in the area of on-orbit transportation as well as during launch and reentry."

a. What circumstances would trigger AST's decision to promulgate additional regulations to ensure public safety?

A1(a). The testimony referred to legislative authority and associated regulation changes. The circumstances which drive a need for revision to legislative authority are a result of the evolving industry and the complexities of the types of technical solutions that are being developed. Specifically, there are four areas where the FAA believes legislative changes may be warranted:

- On-Orbit authority - see full discussion in part B of this question
- Hybrid activities - The current FAA regulatory structure does not fully accommodate non-launch operations of a combined carrier aircraft/launch vehicle system (hybrid activity). Allowing FAA/AST to oversee the entire operation will be more efficient for the operator as well as the FAA.
- Safety Approvals - Clarify the scope of Safety Approvals to facilitate the introduction of safety services and components into the commercial space transportation industry.
- Reentry - Remove the "substantially intact" language from reentry authority; this definition treats vehicles designed to survive reentry in one piece differently from vehicles that break up upon reentry. This is not rational from a public safety perspective because vehicles that break up upon reentry, but do not burn up, can pose an equal or greater public safety risk than those that survive by scattering vehicle components and other debris over a wide area.

In addition, NASA has recently identified the potential need for changes to statutory definitions (such as the one that identifies crew solely as an employee of the licensee) to assist the FAA in working with them on the Commercial Crew Program. We are in the process of evaluating those definitions to determine if a change may be necessary. As to the specific area of future regulatory action, the evolution of the industry is driving revisions intended to improve, clarify, and streamline regulations. Proposed revisions result from lessons learned in issuing licenses and permits, or from changing standards, technology, or hazards in the commercial space transportation industry. In many cases, regulatory revisions can reduce the burden on the industry and the government. For example, the FAA recently issued final regulations that will ease launch window constraints due to concerns about lightning. In the near future, the FAA plans to improve and streamline requirements for the launch of reusable and expendable launch vehicles, for the launch of amateur rockets, and for the operation of launch and reentry sites. Regulatory updates also come from changing standards or technology in the commercial space transportation industry. Additionally, the FAA has several rule updates under consideration to maintain consistency with Air Force and NASA range guidelines, thus reducing the burden on industry.

b. What would be the rationale for seeking greater regulatory authority for on-orbit transportation as well as launch and reentry? What is the scope of on-orbit activities that AST would seek to regulate?

A1(b). The FAA's interest in incorporating on-orbit authority is intended to cover existing gaps in the protection of public and private property on orbit. Two specific examples have been discussed. The first involves NASA's Commercial Resupply Services (CRS) contract. Currently, the FAA's authority ends at the completion of the launch and deployment of the payload. NASA is primarily interested in operations of the payload during proximity operations (23 km from the International Space Station). After the vehicles undock they will maneuver for an orbit or two prior to reentry. Ensuring collision avoidance and prevention of possible damage to property on-orbit is increasingly critical, as the Iridium satellite collision shows. The second example is protection of public and private property on-orbit during commercial space station operations

Q2. During the hearing there was discussion about extending the experimental period for manned space flight systems, but in lieu of a schedule-driven regulatory moratorium, it was suggested that an alternative approach based on performance or other indicators should be considered. In your view, is this a better approach? If yes, what metrics do you believe should be used?

A2. The FAA believes the ability to propose regulations is critical to the safety of commercial space transportation. Rather than wait for a catastrophic or near-catastrophic event to occur, a well-thought out approach to human space flight regulations developed in consultation with industry is needed. To ensure that the appropriate work of considering occupant safety may begin, the FAA opposes the extension of the moratorium on proposing regulations.

We believe the original intent of the Commercial Space Launch Amendments Act moratorium was to preclude regulations from being written before industry had sufficient experience in building and operating commercial human space transportation systems. At the time, it was thought that suborbital space tourism would be the very first commercial human space business, and that commercial human orbital spaceflight was many years away. Suborbital human space flight is following developmental processes similar to aviation in the area of envelope expansion and incremental development, allowing safety insight every step of the way. The FAA has maintained adequate safety oversight through permitted activities and pre-license activities to have confidence in the safety of this part of the industry without the need to actively pursue additional suborbital human spaceflight regulations at this time. See answer to question 4 for more detail on the differences between orbital and suborbital human spaceflight.

NASA's Commercial Crew Program (CCP) has made commercial human orbital flight a much nearer-term proposition than previously expected. Orbital human space flight is a much more substantial safety challenge from the first flight, requiring greater oversight. With orbital human space flight now in its 50th year, there is both sufficient experience and a need to allow the discussions to begin on development of human spaceflight occupant safety regulations.

It takes many years to craft a good regulation; It is important that the FAA begin this work to meet the eventual needs of both NASA-sponsored and non-NASA sponsored flights. Additionally, the availability of potential safety requirements will facilitate orbital commercial space activities by providing greater transparency about the potential regulations future vehicles may need to satisfy.

If metrics are desired, we would be willing to work collaboratively with Congress, NASA, and industry to determine them.

Q3. FAA and NASA are now engaged in discussions on regulating commercial cargo and crew launches to the International Space Station.

a. With respect to commercial cargo, does FAA anticipate promulgating additional regulations to regulate this activity, and if so, how soon do you anticipate publishing a NPRM?

A3(a). At this time, the FAA has the authority and regulations that are needed to license commercial cargo launches to the International Space Station. No additional needed regulations have been identified that are specific to commercial cargo. As mentioned in the answer to question 1B, additional regulatory authority for on-orbit operations to protect public and private property may be warranted, but until Congress provides that authority, there can be no rulemaking in that area.

b. With respect to commercial crew, from FAA's perspective, during the launch phase, how do the agencies distinguish their regulatory roles over the design and performance of the crew capsule and the design and performance of the launch system?

A3b. The FAA derives its authority and responsibilities from the Commercial Space Launch Act, recently re-codified at 51 U.S.C. Subtitle V, ch. 509. The FAA's current regulatory authority extends to launch and reentry operations only as they affect public safety. Therefore, the FAA's oversight of the crew capsule design and performance would be restricted to its impact on public safety and would be exercised through the licensing process. NASA maintains the responsibility for occupant safety and mission assurance. NASA's role is not regulatory. Instead, it imposes requirements for mission assurance and for occupant safety through direct contractual requirements (and related NASA oversight) with the launch or capsule designer/operator.

The Commercial Space Launch Amendments Act of 2004 restricts the FAA's ability to protect persons on board a launch or reentry vehicle until the end of CY2012, unless there has been a death or serious injury to crew or a space flight participant

during a licensed or permitted human space flight; or there has been an unplanned event or series of events during a licensed or permitted flight that posed a high risk of causing a serious injury or death. At some point after CY2012, the FAA may exercise its responsibility for occupant safety as its regulations and experience mature, but the timeline for that transition with regards to the Commercial Crew Program will be determined in the future. NASA will retain the responsibility for mission assurance.

Questions submitted by Representative Jerry Costello

Q1. What is AST's FY 2011 funding level? We have been trying to obtain this information, and it has been some time since Congress passed a final FY 2011 appropriation. Please deliver to us a final FY 11 funding level for AST at the earliest possible date.

A1. AST's FY 2011 funding allotment was \$15,021,161.

Q2. Within the FY 2012 request for AST, how would you prioritize AST's programs and activities?

A2. AST's top-priority activities are those that are intended to ensure public safety, including issuing licenses and permits, conducting hazard analyses, developing regulations, and performing safety inspections. These activities account for approximately 40% of our FY 2012 request. Our second priority activities are those related to enabling industry, including preparing market forecasts and other publications, and awarding spaceport infrastructure grants. For FY 2012 only, a space transportation incentives program is included that is intended to encourage the development of low-cost access to space for a variety of government, industry, and academic users. These activities constitute approximately 27% of our request. Third priority is our safety-related research efforts, including work done by the Center of Excellence for Commercial Space Transportation, totaling 13% of our request. Fourth priority is our activities in support of international and interagency coordination, including significant interactions with both NASA and the US Air Force, totaling 12% of our request. Finally, fifth priority is the work we are doing related to Space Traffic Management. This area represents about 7% of our request, but is expected to grow in future years.

Q3. Your FY 2012 request includes \$5 million to "establish a program for incentivizing advancements in space transportation by non-governmental organizations". Your justification further states that "The Low Cost Access to Space Incentive would provide a \$5 million award designed to jump-start the creation of an entirely new market segment."

a. In this time of tight budgets, why is providing such prizes a priority for FAA, which is an operational and regulatory agency?

A3(a). The FAA supports the President's Innovation Initiative and Congress' America COMPETES Act by offering this prize, which is intended to stimulate private investment in low-cost access to space. The incentive model has a long history in aviation and other transportation industries of stimulating innovation to the benefit of the whole industry. According to the Congressional Research Service, the return on investment for the NASA Lunar Lander Challenge was 6 times the prize amount, and Ansari X Prize Foundation leaders have estimated that 10 times the prize amount was invested by the industry. Prizes also offer a unique advantage in that money is not expended until the objectives have been successfully achieved.

b. Having recently experienced a reduction to both its Facilities and Equipment and Research and Development appropriations in the recently passed Continuing Resolution for FY 2011, is FAA prepared to carve out \$5 million of its budget to fund the space incentives program if similar reductions are made to FAA's FY 2012 budget?

A3(b). The FAA's top priority is ensuring public safety, to include licenses and permits with supporting analyses; safety inspections; and tools related to license analysis. Activities supporting the economic competitiveness of the commercial space transportation industry, such as the Space Incentive program, are of secondary priority. In the event of budgetary reductions, the FAA would focus its resources on its highest priority safety mission.

c. Does it make sense for an agency with primary regulatory responsibility to undertake such a program rather than R&D organizations who are not so en-

cumbered, such as the National Science Foundation or NASA or, alternatively, the Department of Commerce's Office of Space Commercialization?

A3(c). The FAA's regulatory role does not preclude its ability to be a meaningful R&D organization as well. Although seemingly small (\$170 million in FY11) in comparison to the budget numbers for other R&D organizations, the R&D activities conducted by FAA lines of business are important components of and large contributors to the development and execution of FAA's regulatory authority. This prize is specifically designed not to overlap with any NASA prize initiative. The FAA believes this prize will encourage transportation technologies, rather than support an agency specific mission. The FAA is in a unique position to understand commercial space transportation, and the incentive is intended to specifically support the space transportation industry. There are no US government programs aimed at reducing the costs of access to space by developing reusable space launch systems to build upon the advancements of the Space Shuttle. Reusability is widely recognized and accepted as being a necessary technology before commercial space transportation can achieve its full potential.

The National Science Foundation supports science research, not systems development, so there is no overlap. The Department of Commerce has not pursued any space-related prize initiatives.

Q4. A 2008 report conducted by the Aerospace Corporation pursuant to direction in the 2004 Commercial Space Launch Amendments Act found that human sub-orbital and orbital flights should be regulated differently. What is the AST doing to understand the risks specific to suborbital and to orbital systems and how is it using that information to inform its approach to safety and regulations?

A4. This is a very important question, and the FAA is in a unique position to see the differences between orbital and sub-orbital operations through our work with licensing and permits. Suborbital flights are developing with more of a build-up approach, similar to aircraft development, and involve a shorter duration of exposure to the hazards of space. As a result, the FAA has elected not to pursue suborbital human space flight regulatory changes once the 2012 moratorium expires. We believe that we have adequate insight to the safety levels of sub-orbital vehicles through the development and envelope expansion that take place during flight testing. However, orbital operations are by their nature "all-or-nothing" in that the vehicle must achieve orbit completely in order to be successful, and the duration of exposure to the hazards of space is much more substantial. The FAA believes that the development of orbital spaceflight regulations must begin soon in order to ensure consistency of approach among all government agencies for the benefit of industry.

With regards to studying the risks specific to suborbital and orbital systems, the FAA is investigating the health effects of spaceflight on participants from the general public—as opposed to highly trained and healthy astronauts. In addition, the FAA is investigating the effects of frequent space launch activities on the National Air Space System and associated impacts to commercial airline operations. An "anomaly database" is being developed to track unexpected events in commercial space transportation that relate to safety. Finally, the FAA is sponsoring several areas of research under the Center of Excellence that directly relate to industry safety issues.

Q5. To what extent has FAA been involved in NASA's commercial crew development (CCDev) program and in the selection of funding recipients for NASA's CCDev2 solicitation and what further involvement, if any is planned?

A5. The FAA has two full time employees located in the NASA Johnson Space Center Commercial Resupply Services (CRS) office and one in the NASA Kennedy Space Center Commercial Crew Program (CCP) office to coordinate and communicate regarding these interagency topics. NASA has one full time employee at FAA Headquarters in Washington DC for the same purposes. The FAA participated in NASA's review and evaluation of CCDev proposals but was not a "voting member" in the selection of winning proposals for contract. Our participation was to ensure that relevant FAA regulatory requirements were properly addressed in the acquisition process. The FAA and NASA are actively engaged in discussions to determine the best path forward to strengthen our government partnership both to increase safety and to benefit industry.

- a. *What, in your view, would give FAA the authority to impose safety regulations for NASA crew members that may fly on commercial spaceflight systems for ISS crew rotations rather than having NASA do it?*

A5(a). 51 U.S.C. §50905(c) provides the FAA authority to issue regulations governing the design or operation of a launch vehicle operating under an FAA license to protect the health and safety of crew and space flight participants. The intent of the Commercial Crew Program (CCP) is to develop a commercial capability for launches to the ISS. Since the FAA licenses commercial launches, it is the intent of both NASA and the FAA that the FAA will ultimately license these launches within the limits of its regulatory authority. This is to industry's benefit so that it may leverage the developments of the CCP to extend to non-NASA customers. For licensed operations, the FAA has responsibility for public safety. At some time in the future, and after the expiration for the 2012 moratorium, NASA and the FAA may agree that the FAA will exercise responsibility for occupant safety as well.

- b. *What are FAA's plans for working with NASA on human rating requirements and safety for potential commercial human spaceflight operations involving government crew?*

A5(b). A Memorandum of Understanding (MOU) between the NASA Commercial Resupply Services Program and the FAA is already in place, and an MOU between the NASA Commercial Crew Program (CCP) and the FAA is currently being drafted. The FAA and NASA CCP have been conducting joint reviews of NASA's requirements and FAA regulations to determine if there are any incompatibilities or conflicts between them. We are also examining how the FAA's regulations would apply under various acquisition strategies being considered by NASA. As part of our ongoing collaboration, the FAA attended NASA's requirements workshop in June 2011. The FAA will continue to stay abreast of requirements development in order to ensure consistency, to reduce industry's data burden, and ensure that industry can leverage the developments of the CCP to extend to non-NASA customers.

- Q6. *What specific issues and questions does Congress need to consider before determining how to handle accidents or collisions that may occur on-orbit?*

A6. Space mishap investigation is extremely challenging, partly because of the remote environment that hampers investigation and partly because many entities could be involved or have a stake in the investigation and the outcome. In order to address this problem, the FAA, NASA, and the NTSB have a Mishap Tri-Chair Working Group which meets monthly; they have agreed to a matrix of responsibilities if a mishap occurs based on their discussions. This matrix would likely be of value to Congress in framing the discussion.

Congress should consider these specific issues when determining how to handle accidents or collisions that may occur on-orbit:

- a. On-orbit authority
- b. Liability and indemnification issues under U.S. laws and international treaties
- c. Which entity is best suited to conduct the efforts during the various stages or components of an investigation most efficiently; these stages include detection, data-gathering, investigation, compliance, enforcement, and international coordination
- d. Existing treaties and legislation regarding mishaps involving NASA or NASA-contracted vehicles, to include:
 - The Astronaut Rescue Agreement
 - The National Aeronautics and Space Administration Authorization Act of 2005, (specifically Section 822).

- Q7. *In your testimony, you noted that having one set of requirements for NASA and one for FAA would not allow companies to close their business cases. Would not having regulations in place at the time of any future NASA commercial spaceflights for ISS crew rotations be a show-stopper for companies?*

A7. Many in the industry have expressed a desire for the FAA to begin developing occupant safety regulations for human spaceflight to provide confidence to their investors that the appropriate regulatory structure is in place to use the commercial vehicles they develop in support of NASA's requirements for non-NASA missions. Not having regulations compatible with the requirements that guided the development of the vehicles could lead to delays in licensing these vehicles commercially.

Q8. In your prepared statement, you said that in FY 2012 you “expect several dozen licensed or permitted launches”. How many of those will be licensed launches? What is the basis of your expectation?

A8. A conservative estimate, taking into consideration range and technical delays, is that there will be 20 - 25 licensed launches during FY 2012, of which 12 - 15 will be orbital launches and 8 - 10 will be suborbital launches. Permitted launches are much more difficult to estimate. Based on self-reported intentions of industry combined with prudent judgment of the uncertainties, we believe a number of commercial reusable launch operators will conduct 20 - 30 research and development launches in FY2012 under experimental permits. In total, we expect 40 - 55 licensed or permitted launches during FY2012. The basis of our expectation is from analysis of current launch manifests, industry reported intentions, and existing contracts. The sum total of these projections is subject to a high level of uncertainty for various reasons, therefore the FAA has revised the total down to a more conservative number.

Q9. You noted in testimony that “ensuring that the liability structure that is set up is appropriate” for allowing businesses to compete internationally will be important for the success of the commercial human spaceflight industry. Could you please elaborate on how the current liability structure in the U.S. compares to the liability structure internationally and how the U.S. structure may affect competition?

A9. The current U.S. regime, set forth under Title 51, Chapter 509, has three tiers.

Tier I: Maximum Probable Loss (MPL)-Based Financial Responsibility Requirements. The launch licensee is required to obtain insurance to cover claims of third parties, including government personnel. The FAA sets the requirements based on the largest accident probable, not possible, that would result from licensed launch or reentry activities, not to exceed the lesser of \$500 million for third party liability, or the maximum available on the world market at reasonable cost or \$100 million for U.S. Government range property, or the maximum available on the world market at reasonable cost.

Tier II: Catastrophic Loss Protection (Government Payment of Excess Claims, Known as “Indemnification”). Subject to appropriations, the U.S. Government may pay successful third-party liability claims in excess of required MPL-based insurance up to \$1.5 billion [\$2.7 billion adjusted for inflation]. The U.S. Government waives claims for government property damage above required property insurance.

Tier III: Above MPL-Based Insurance plus Indemnification. If a claim exceeds Tier I and II the remaining financial responsibility reverts back to the licensee or legally liable party.

The following are examples from the leading providers of commercial services for expendable launch vehicles:

“Arianespace shall be required to reimburse the French government, up to a ceiling of 60 million euros per launch [about \$85 million in 2011], in the case of damages caused by Ariane launches. Arianespace typically purchases insurance to cover this amount. If the damages exceed this amount the French government is obliged to indemnify the difference.”¹

In Russia, “[t]ypical levels of compulsory insurance vary from \$80 million for Start launch vehicles to \$300 million for Soyuz and Proton. The Russian government pays liability claims in excess of insurance coverage if this specified in the launch services contract. If it is not, the launch customer is liable for these claims.”²

In the expendable launch vehicle (ELV) satellite services market, if there was no U.S. Government indemnification, the FAA believes that U.S. providers would be unable to compete against foreign providers. Industry has stated the same position.³ In addition, as detailed in the 2006 report to Congress: “. . . private insurance markets still are not able to provide full liability (maximum probable loss) coverage to the commercial launch industry. Private liability insurance capacity remains fragile and far below what would be needed to compensate for government indemnification if it were eliminated. Foreign

¹ “Study of Liability Risk-Sharing Regime in the United States for Commercial Space Transportation” page 48, August 1, 2006. This report, in response to Public Law 108-492, is available at: http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/

² Ibid, page 52.

³ Ibid, page 36-37.

competition has increased, and all credible international competitors have risk-sharing schemes rivaling or surpassing that of the U.S.”⁴

Regarding human space flight, the 2004 Commercial Space Launch Amendments Act excludes space flight participants from indemnification eligibility against third party claims. If a foreign human space flight competitor had indemnification and the U.S. did not, the FAA believes that in the mid-to-long term, the U.S. human space flight industry—both orbital and suborbital—would be negatively impacted.

Given the approach to date in ELVs for satellites, foreign competitors may try to institute an indemnification system that is more favorable to industry than the U.S. liability regime for human space flight.

The FAA’s commercial space industry advisory committee, COMSTAC, told the FAA on June 1, 2011: “We advocate increased protection of operators and their associates when they serve spaceflight participants. While the specific mechanism is yet to be determined, the current indemnification regime (i.e., private insurance up to \$500M, Government indemnification to \$1.5B over that) would seem to be the correct way to achieve this protection.”

Q10. To what extent is data being collected to understand the range safety implications of different designs and approaches for commercial spaceflight systems and to inform any potential changes in regulations? Does FAA have access to company-proprietary data?

A10. Range safety implications of a design are always reviewed and analyzed in detail for each licensed or permitted launch, including proprietary data. We track and annually review with the US Air Force all waivers and exceptions to safety systems that were considered or granted by the USAF and the FAA. The FAA has four full time employees located at Patrick AFB (Eastern Range) for these purposes, with direct support provided from other FAA staff as required.

We actively and continuously participate in joint USAF/FAA Common Standards Working Groups and in the USAF Range Commanders Council. There is a constant evolution of range operations and the FAA has several rule updates in consideration now to maintain consistency with USAF and NASA range guidelines.

Questions submitted by Representative David Wu

Q1. What did FAA use as evidence of a commercial market to justify the significant increase in workforce and supporting activities detailed in its FY 2012 budget request, especially since the commercial market assessment for crew and cargo systems that NASA recently transmitted to Congress was not completed at the time of the FY 2012 budget process?

A1. The FY2012 budget request for AST was based upon a variety of factors that affect our workforce and supporting activities. These factors include the number of commercial space launches anticipated in FY2012, but also include the increase in the breadth and complexity of planned commercial space operations. Measuring this increase is challenging to do; however, market assessments are one good option. This is why the FAA annually conducts our own commercial space transportation industry orbital market assessment. We provided this data to NASA for its report, including having our market analysis contractor perform specific new market assessments for NASA to use in its report.

Additionally, the FAA regularly polls industry as to its intended schedules. This is particularly crucial in the area of suborbital markets, where data is more difficult to obtain.

Another indicator of potential future activity is the amount of money being invested in the industry. The FAA notes that between the Commercial Resupply Services (CRS) contracts, CCDev and Commercial Crew Program (CCP), and the Commercial Reusable Suborbital Research (CRuSR) program, NASA has been ramping up investment in the commercial space industry. Previously insignificant figures from a few years ago have increased to over \$800 million in FY2011. \$1.6 billion has been proposed for FY 2012 and subsequent years. Although the investments will take time to mature into actual launch events, NASA’s investments alone will create a large increase in activities requiring the FAA’s engagement as industry progresses towards licensed launch events.

⁴ Ibid., page 10, Executive Summary

*Responses by Dr. Gerald Dillingham, Director, Physical Infrastructure,
US Government Accountability Office*

Questions submitted by Chairman Steven Palazzo

Q1. During the hearing there was discussion about extending the experimental period for manned space flight systems, but in lieu of a schedule-driven regulatory moratorium, it was suggested that an alternative approach based on performance or other indicators should be considered. In your view, is this a better approach? If yes, what metrics do you believe should be used?

A1. GAO Response: Yes, we believe that a performance-driven approach is better than a schedule-driven approach. In 2006, we recommended that the Federal Aviation Administration's (FAA) Office of Commercial Space Transportation (AST) identify and monitor safety indicators for manned spaceflight so that it could be proactive in determining when to regulate crew and flight participant safety.¹ The agency has not implemented our recommendation because commercial manned space flight has not yet occurred. However, in the absence of such flights, metrics could be used along the lines suggested by Dr. Hertzfeld in his testimony. We agree with Dr. Hertzfeld that such metrics could take into account factors such as the maturity of the industry; the ability of companies to operate on a routine, scheduled basis; the number of passengers and the amount of cargo transported or the number of research experiments flown; the standardization of vehicles and systems that could provide the basis for a vehicle certification regime; and a quantification of the different risks involved.

Q2. As part of its FY2012 budget request, AST is proposing greater regulatory authority in the area of on-orbit transportation. Does GAO agree with this concept? Does AST have the resources and expertise?

A2. GAO Response: Ultimately, increasing AST's regulatory authority is a policy decision for the Congress. We have not completed the work that would provide a basis for discussing the regulatory authority for on-orbit transportation. Likewise, we have not assessed whether AST has the resources and expertise to undertake significant additional regulatory responsibility in this area.

Questions submitted by Representative Jerry Costello

Q1. What liability and indemnification issues would commercial human spaceflight vehicles carrying U.S. government astronauts or crew raise?

- a. What issues are raised when both government crew and paying spaceflight participants are onboard together?*
- b. What are the most critical issues for Congress to consider?*

A1. GAO Response: Currently, for commercial launches licensed by the Federal Aviation Administration (FAA), the U.S. government may pay third-party liability claims in excess of required launch insurance, up to \$1.5 billion. This catastrophic loss protection in the event of a commercial launch incident is known as indemnification. The National Aeronautics and Space Administration's (NASA) current plan calls for launch contractors to obtain an FAA license for crew flights to the International Space Station and, therefore, these flights would be covered under this government indemnification. Additionally, space tourism flights require an FAA license and would also be covered under this government indemnification. Congress could consider several issues related to indemnification such as: (1) the point at which the industry will have outgrown the need for federal indemnification; (2) if federal indemnification is eliminated, how much time should be provided for industry to develop alternatives to government indemnification; and (3) if federal indemnification continues, whether an overall funding cap should be established.

Q2. What does Congress need to understand before determining how accident investigations for commercial human spaceflight and suborbital flights should be handled, including on-orbit accidents?

- a. Should the process and authority for accident investigation be the same or different if humans are involved?*

¹ GAO, Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry, GAO-07-16 (Washington, D.C.: Oct. 20, 2006).

b. Should the same organization that investigates launches also investigate on orbit accidents and if not, why not?

A2. GAO Response: As we reported in 2009, the role of the National Transportation Safety Board (NTSB) in investigating space flight accidents has not been resolved and, to our knowledge, that issue remains unresolved. NTSB does not have space transportation explicitly included in its statutory jurisdiction, although it does have agreements with FAA and the Air Force under which it will lead investigations of commercial space launch accidents.² A 2008 FAA-commissioned report on human space flight suggested that Congress may want to consider explicitly designating a lead agency for accident investigations involving space vehicles to avoid potential overlapping jurisdictions.³

Q3. How should any potential civil space traffic management regime correspond to national security needs for space traffic management and space situational awareness?

a. Should these functions be handled separately or by one entity?

b. What criteria should inform the decision of what entity (or entities) is given authority for space traffic management?

A3. GAO Response: Our work indicates that a civil space traffic management function, which could be carried out by one entity, would have to be coordinated or linked with the national security community and specifically with the Department of Defense's U.S. Strategic Command-the organization responsible for executing the space situational awareness mission.⁴ We have no basis to recommend any one entity to handle this function.

Q4. The 2004 Act limits the commercial human spaceflight safety regime to "informed consent." Should Congress revisit that approach?

A4. GAO Response: Because commercial space flights have not yet begun, we do not have any basis to challenge the concept of "informed consent." Congress could revisit the issue after the industry develops further and FAA develops safety regulations for human space flight, which would replace the informed consent regime.

² GAO, Commercial Space Transportation: Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles, GAO-10-286T (Washington, D.C.: Dec. 2, 2009).

³ The Aerospace Corporation, et al., Analysis of Human Space Flight Safety, Report to Congress (El Segundo, Calif.: Nov. 11, 2008).

⁴ GAO, Space Acquisitions: Development and Oversight Challenges in Delivering Improved Space Situational Awareness Capabilities, GAO-11-545 (Washington, D.C.: May 27, 2011).

Responses by Dr. Henry R. Hertzfeld, Research Professor of Space Policy and International Affairs, Elliott School of International Affairs, George Washington University

Questions submitted by Chairman Steven Palazzo

Q1. As part of its FY2012 budget request AST is proposing greater regulatory authority in the area of on-orbit transportation. Your statement also notes the need for new regulatory authority. For the near term (next ten years), what on-orbit activities do you believe merit the highest concern, and what tools does AST need to regulate them?

A1. There is an assumption built into the question that the AST will be the regulator of all on-orbit activities for the United States Government payloads on commercial space flights as well as the commercial sector. I do believe that the U.S. will need more on-orbit supervision of its activities, but the FAA is not the regulator for all commercial on-orbit activities, whether government-sponsored or not.

NASA, NOAA, and the DOD have been performing in-orbit activities since the 1960s and have adequately developed technical means to perform in-orbit activities. They have the full support of overall government policy based on our treaty obligations and requirements should liability issues arise from their activities in space. The safety record of government operations in space, although not perfect in the hazardous environment of space, has generally been as good as reasonably could be expected. And, it has improved with the lessons learned from experience.

But, Congress has not given any federal agency the mandate to fully regulate commercial on-orbit activities. The space regulatory agencies, the FAA, NOAA and the FCC, have issued rules and regulations for launches that extend the launching activity to the placement in the proper orbit of a payload and to the on-orbit preparations for re-entry. Additionally, the FCC and NOAA have end-of-life requirements that requires payloads to safely be put into "graveyard orbits" or deorbited.

Specifically, meeting the liability obligations of the space treaties (particularly Article VII of the Outer Space Treaty and Articles III and IV of the Liability Convention) may involve the finding of fault for accidents in space. If a U.S. payload is at fault, the U.S. Government is liable for damages to the assets of another State Party to the Convention. The Government can then turn to a commercial operator of that satellite or payload and attempt to recover those damage payments. However, currently there are no requirements for commercial firms to purchase insurance for on-orbit activities, although some companies do. (Iridium, a U.S. company which was involved in a serious accident a couple of years ago, did not insure its satellites. Fortunately, there was no significant near-term economic damage in space from that accident.)

Whether it is through requiring the commercial operator of a space asset to purchase private insurance or through some other financial arrangement, Congress should consider a new on-orbit commercial protocol for space activities. Additionally, the government needs to do more to prevent accidents. The recent U.S. policy adopting the IADC Debris Mitigation Guidelines as well as increasing the coordination and accuracy of SSA is an example of what has already begun in the U.S. Although the FAA has been involved, it is only one part of the broad reaching regulatory system that will be needed.

Q2. FAA and NASA are now engaged in discussions on regulating commercial cargo and crew launches to the International Space Station, especially with regard to crew safety, third-party safety, and International Space Station proximity operations. Current proposals suggests that NASA would certify crew capsules used to carry government astronauts to and from orbit, while FAA would license their launch. What are your thoughts about this division of responsibility? In your view, is it sensible? What steps should be taken to ensure there are no safety 'gaps'?

A2. I would need to know more about what is now being discussed between the FAA and NASA, but I am concerned about this division of responsibilities. Currently, FAA certifies airplanes for flight; it does not certify space vehicles-it only licenses them subject to a safety review and a showing of financial liability. FAA aviation certification is a well-developed system and the rules and requirements are codified. NASA "certifies" the Shuttle. That is really different process than aviation certification and is more like a quality control process. Each Shuttle flight is separately certified while aircraft certification is valid for all flights of a particular type of airplane. There is no current certification procedure for commercial space vehicles, either by the government or by industry. Developing a certification process for

a launch vehicle and its payload is an entirely new concept and will take years of work and experience before it could reach the level of assurance now in place for aviation.

I don't see any essential reason for the FAA to get involved in technical issues of on-orbit activity for a government payload. NASA is well positioned to do that. Dividing the responsibility between the FAA and NASA will only create difficult communications problems between the Agencies and could possibly increase the risk of accidents rather than reduce them.

Launching government satellites on U.S. commercial launch vehicles does not require an FAA license. If the launch is for a dedicated government payload, then NASA procedures (or DOD) are applied for safety reviews and financial responsibility remains a Government guarantee. However, companies may prefer to go through the FAA and get a license. This may be advantageous for the company for two reasons: 1) the vehicle may be similar to others of its class and already covered under an FAA review, and 2) it may provide an extra measure of assurance for the company should anything go wrong with the launch. But, to emphasize again, it is not absolutely necessary that a commercial launch get a license from the FAA for dedicated NASA payloads.

In the case of ISS supply, even though the current trend in policy is to have NASA pay for commercial services, rather than build space hardware themselves or through an R&D contract, NASA is still the customer. If NASA wants to impose its own criteria for safety and it (or the Government) is able to indemnify those activities, and if NASA is willing to pay for the extra safeguards that it wants, there is precedent to bypass the FAA licensing procedures on those particular launches.

Since a commercial company launching NASA cargo and eventually crew to the ISS will also want to market those services and capabilities to private customers, they may desire an FAA license for NASA launches as a marketing and quality assurance tool for other commercial sales.

A benefit of involving the FAA as an observer, advisor, and partner in NASA missions (but not as a regulator) would be the development of a good database of operations for launch and on-orbit activities. Eventually the FAA can make good use of the accumulated data and experience in developing future regulations of purely commercial launches and on-orbit activities. This is particularly relevant for the future unknowns of private human activity in orbit and for the ISS.

Questions submitted by Representative Jerry Costello

Q1. What liability and indemnification issues would commercial human spaceflight vehicles carrying U.S. government astronauts or crew raise?

- a. What issues are raised when both government crew and paying spaceflight participants are onboard together?*
- b. What are the most critical issues for Congress to consider?*

A1. Liability in space is an untested legal regime, particularly for commercial enterprises in space. Through Article VI of the Outer Space treaty, States are responsible for the activities in space of their citizens and non-governmental entities. This provision exposes the State to potential payment for damages to the assets of other nations caused, not directly by the State, but by one of its companies operating in space. No other industry or sector is treated this way. In other high-technology, high-damage industries such as civil nuclear plants or large oil platforms, the operator has the primary responsibility for liability payments with governments sometimes a secondary guarantor.

Domestic law, it should be noted, often can and will require a company to have insurance (FAA does this now with launches) so that the exposure of the government is actually minimized, except in exceptional situations.

- a)* The mixing of government personnel with private crew and/or private passengers is complicated. The problems are as diverse as the reasons for having private citizens on a spacecraft. Are they government contractors? Are they "tourists?" Are they doing private R&D or science related to a government project? Each scenario might trigger a different legal answer.

It is possible that those passengers can get in the way of mission personnel (space vehicles are not roomy and it is impossible to physically separate private from government people). If an accident occurred as a result, as they have on ships and submarines, assigning liability is of concern. Informed consent is not enough in these cases; the passengers and companies involved must have comprehensive financial responsibility procedures for all types of fault-based liability.

Q2. The 2004 Act limits the commercial human spaceflight safety regime to “informed consent”. Should Congress revisit that approach?

A2. Yes, it should be reviewed. Informed consent from passengers is aimed at sub-orbital human flights and at stimulating the companies by not requiring them to insure their passengers who recognize, through informed consent statements, that they are taking certain risks. The informed consent requirement also makes it clear to the passenger that the FAA has not certified the vehicle or flight (and may therefore absolve the Government from being sued by the passenger).

However, as mentioned in the testimony, four States that have spaceports are now moving to further protect the private launch companies from virtually any legal suits from passengers. Each State has slightly different wording in its laws which may now result in competition among the various States for launch operators to locate there based on the costs associated with safety issues. (Economic competition based on the price of the flight and on other incentives States may give companies such as building facilities or providing tax incentives should not be discouraged.)

Furthermore, these types of informed consent waivers that protect the companies may not even be practical from a legal view. For instance, if a launch originates in New Mexico (a state with an informed consent law) and then has an accident in U.S. airspace above Colorado (a state without such a law), Colorado tort law would be applied to the accident and it is highly probable that a Colorado court would not allow the application of that waiver to the launch company. Predictability and uniformity in these safety regulations across the U.S. would be preferable.

Q3. What does Congress need to understand before determining how accident investigations for commercial human spaceflight and suborbital flights should be handled, including on-orbit accidents?

a. Should the process and authority for accident investigation be the same or different if humans are involved?

b. Should the same organization that investigates launches also investigate on-orbit accidents and if not, why not?

A3. The expertise required to investigate an accident involving space technologies is quite limited. Only a very few agencies (e.g. NASA, DOD, and some parts of DOT and others) have the expertise to perform the analyses required. Historically, all agencies as well as private consultants, industry experts, etc. have fully cooperated in these investigations. I do not believe there has been any serious problem in obtaining that cooperation.

Therefore, I believe that it is not a question of accidents with or without humans, or accidents involving space hardware on Earth, during launch, in-orbit, or returning from orbit, but only one of clearly designating one organization to coordinate an accident investigation. That organization could take any format ranging from an ad hoc office or Board within an agency such as NASA or DOT created especially for each commercial space accident to a more formal office created within an agency organized specifically to develop protocols and procedures for a space accident. That organization should be given all necessary legal powers to conduct an investigation, obtain evidence, review and keep secure any confidential information (classified or commercially proprietary) and procure all necessary technical expertise. The investigatory panel should be completely independent of the Agency hierarchy and should report directly to either (or both) the President and Congress.

There are several possible locations (none need to be permanent organizations or office) for this independent activity. NASA itself has a safety office and advisory group that could create an investigation panel. The DOT/FAA might also be appropriate, but it currently does not have a full spectrum of technical space expertise. The NTSB is an independent body within the Executive Branch but does not specifically have space in its legislative charter. It does, however, have the organizational expertise to conduct accident investigations in other transportation modes and currently does have a MOU with the FAA for the investigation of certain space-related accidents.

Q4. How should any potential civil space traffic management regime correspond to national security needs for space traffic management and space situational awareness?

a. Should these functions be handled separately or by one entity?

b. What criteria should inform the decision of what entity (or entities) is given authority for space traffic management?

A4. This is not my specific expertise. I do believe that the key to a successful regime for space traffic management must be coordination, just as it is for air traffic con-

trol. And, of course, to get to space or to get back from space involves going through air space. Therefore, on either a national or international level, not only does space traffic management have to be coordinated in space itself, but also it must be coordinated with air traffic control.

Therefore, whether one entity does both or whether there are different organizations controlling traffic in and to space, they must work together (and also interface smoothly with military traffic command, as is also done currently with air traffic control).

Criteria for this decision should rest mainly on the ability to coordinate the information required. The range of information is vast and complicated and with the global reach of space, will involve access to many different types of information such as air traffic data, weather data, space weather data, national and international launch information. The function will also require a sophisticated level of analysis and the ability to make real-time decisions.

Q5. Should FAA require evidence of a real demand for launch services at a prospective spaceport prior to investing its resources for the work leading to granting a license?

A5. This is a difficult question. If and when there is a surge of private space launch activity, the FAA will need the resources. However, at present, the FAA data indicate that number of commercial launches is slightly over 10 per year. Forecasts indicate that the number of launches will remain relatively stable for the next several years and may rise to near 20 per year late in this decade. But, those forecasts are based on a number of assumptions, including the success of the NASA-led effort for commercial crew and cargo flights to the ISS.

It appears from these numbers there will no surges in launch activity in the immediate future. But, given the many differences in the technical approach to launching from the private companies now building new and experimental launch vehicles that the FAA will need for a broad range of technical expertise and possibly new resources to evaluate these different approaches. The FAA is closely monitoring the development of these new vehicles and, as yet, none are commercially operating. Congress should be kept informed and ready to act when and if the FAA needs the resources to adequately license these new vehicles and possible new surges in launch demand.

Q6. What, if any, risks are raised when range safety at a private spaceport is conducted by the organization that is operating the spaceport, and how should those risks be addressed?

A6. The obvious risks are the inherent decision conflicts between making money in a profit-motivated organization and developing a level of safety that is as high as possible and practicable as it could be. There will always be trade-offs between money and safety; nothing is 100% safe. For the most part, government agencies dealing with space issues are well funded and, particularly when dealing with human safety, will err on the side of spending the funds necessary for a higher level of safety than a private firm would.

On the other hand, a private firm will argue that the government is overly cautious and near equivalents in safety can be met with less expensive investments. And, they argue, that customers will not buy their services if there is a serious safety breach that was responsible for the loss of life.

One way the risks can be addressed and possibly managed in an optimum level for safety is to require the private spaceport to use a new part-time board that would combine government expertise with private sector executives. This relatively small office/panel/board would consist of independent individuals who are experts in appropriate space and ground support technology, operations, law, and safety. This one office would employ a small permanent staff and would be established to oversee and advise all domestic spaceports. The funding for this would be through an obligatory payment or tax from each U.S. spaceport (charged on the basis of a formula to insure a proportionate and fair share payment by each spaceport). Each spaceport would be required to abide by the recommendations of this Board and an FAA license to launch from that facility would be granted only if there were full compliance with those recommendations. The FAA licensing process would be independent from this Board.

One final note on the suggestion for a new Board to be formed (and this note equally applies to a possible new organization for accident investigations mentioned above) is that the demand for spaceports (and the number of accidents that might occur) would warrant the expenditures for these organizations. It might be more appropriate if demand is low to have ad hoc committees of experts both within the Government and outside formed for these purposes.

