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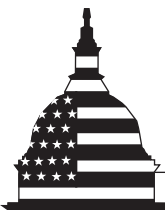
Before the Subcommittee on Space and
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COMMERCIAL SPACE TRANSPORTATION

Industry Trends and Key Issues Affecting Federal Oversight and International Competitiveness

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



G A O

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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 dillinghamg@gao.gov.

May 5, 2011

COMMERCIAL SPACE TRANSPORTATION

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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-10-286T](#) (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.

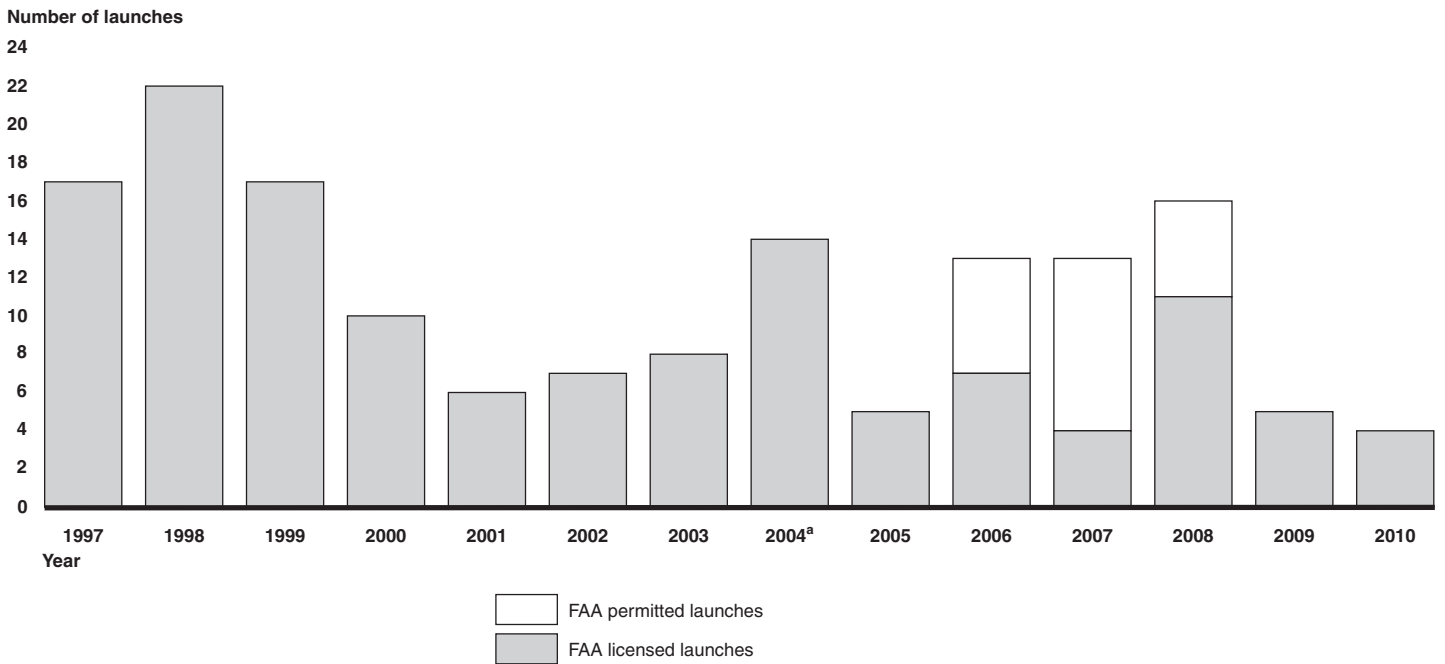
Although anticipated additional manned commercial spaceflights have not materialized, research and development efforts that could lead to manned flights continued following the SpaceShipOne flights. FAA began issuing experimental permits in 2006 to companies seeking to conduct test launches of reusable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



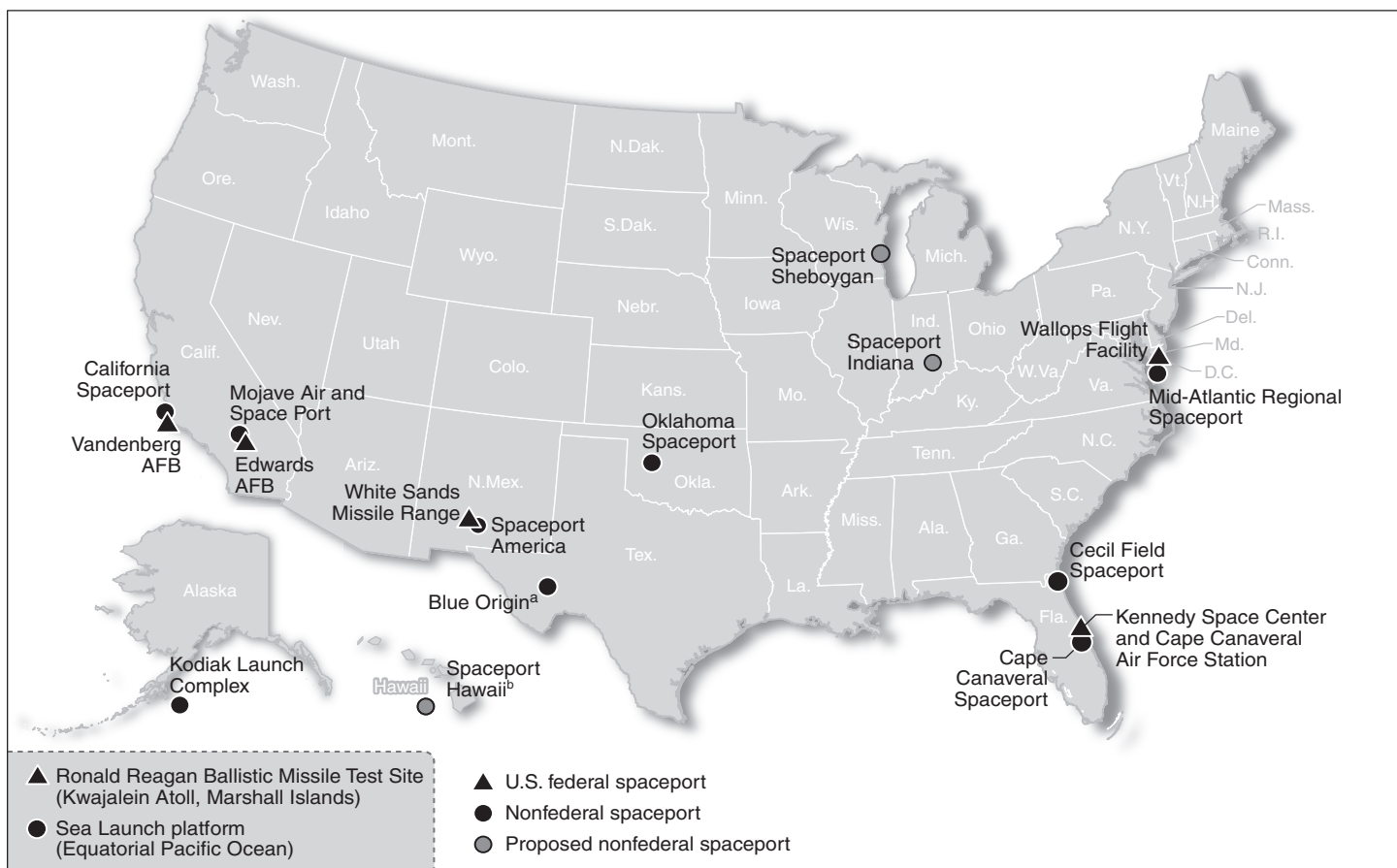
Source: GAO analysis of FAA data.

^aIncludes licensed suborbital launches by Scaled Composites.

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



Sources: FAA and GAO.

^aPrivate facility with a sole site operator.

^bExact location has not been determined.

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



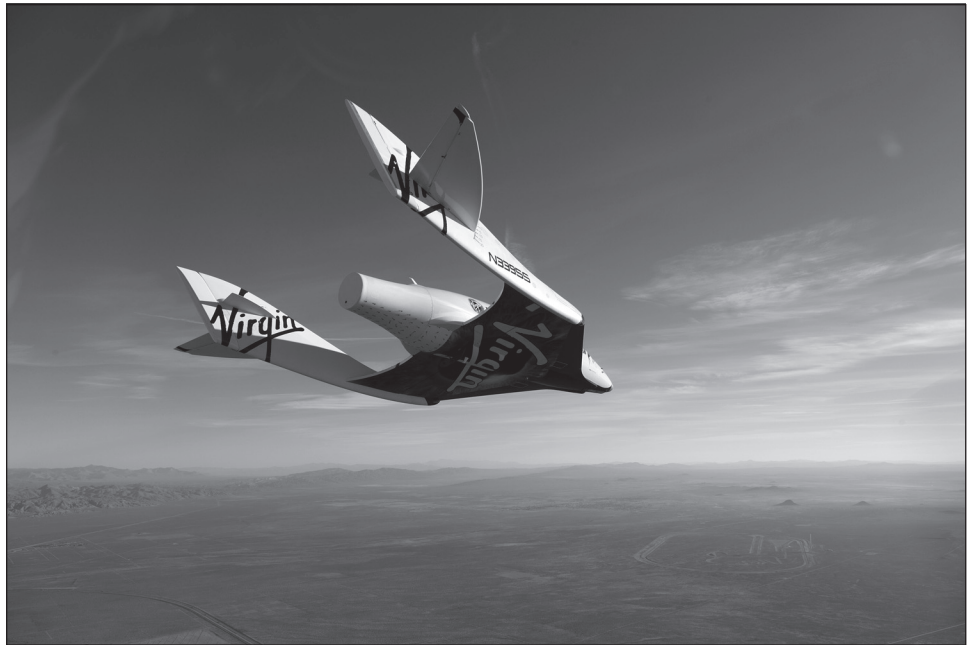
Source: Blue Origin.

Figure 4: XCOR Aerospace's Lynx Space Vehicle



Source: XCOR Aerospace.

Figure 5: Virgin Galactic's SpaceShipTwo Vehicle



Source: Virgin Galactic.

Additionally, FAA licensing and oversight responsibilities will likely increase as NASA begins this year to use vehicles developed and operated by commercial partners Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation (Orbital) to deliver cargo to the International Space Station following the last of the space shuttle flights this summer. In December 2010, SpaceX conducted an FAA-licensed demonstration flight of its Falcon 9 launch vehicle and Dragon space capsule, and successfully retrieved the capsule after it completed its orbit and reentry maneuvers. A second demonstration flight is planned for later this year, along with the first demonstration flight of Orbital's Taurus II launch vehicle and Cygnus spacecraft.⁸ NASA has awarded Commercial Resupply Services (CRS) contracts for 12 SpaceX flights and eight Orbital flights to deliver cargo to the International Space Station once the demonstration flights are completed successfully. FAA is the licensing authority for the

⁸The SpaceX and Orbital Sciences tests were or will be conducted in fulfillment of Space Act agreement milestones under NASA's Commercial Orbital Transportation Services Program.

demonstration flights as well as for the flights to be carried out under the CRS contracts.

NASA eventually plans to use commercial systems to transport agency crew members to the International Space Station and has initiated the Commercial Crew Development Program to further these plans. Specifically, in January 2010 the agency entered into several Space Act agreements⁹ totaling \$50 million to provide financial and advisory assistance to private companies developing spacecraft and related systems for human spaceflight. Last month, NASA announced a new round of agreements totaling \$269 million to further mature system concepts.¹⁰ NASA ultimately plans to contract with commercial partners to certify vehicles for human spaceflight and to procure crew transportation services; however, it is unclear at this point what role FAA will have in licensing such vehicles and services and, therefore, it is not clear how such contracts will affect FAA's workload. Further, FAA licensing applies only to vehicle launch and reentry operations and not to in-orbit activities. NASA officials are in the process of determining the extent to which the agency will exercise its own launch authority for commercial human spaceflight (versus a commercial launch license from the FAA) as they evaluate the impact FAA licensing would have on their ability to impose NASA's own safety and mission assurance requirements on commercial partners. NASA officials are also weighing issues concerning indemnification for commercial partners against catastrophic third-party loss (i.e., loss to a party other than the government or the commercial provider). We will evaluate NASA's commercial crew transportation procurement strategy, insight and oversight plans, and indemnification approach—which NASA officials expect to provide to Congress in June—in response to a mandate in the NASA Authorization Act of 2010¹¹ and expect to issue a report later this year.

⁹Agreements NASA issues pursuant to their authority under the National Aeronautics and Space Act of 1958, as amended. 42 U.S.C. § 4273(c)(5) and (6).

¹⁰NASA signed Space Act agreements with five companies in the first round of its Commercial Crew Development Program: Blue Origin, The Boeing Company, Paragon Space Development Corporation, Sierra Nevada Corporation, and United Launch Alliance. In the second round of the program, NASA awarded agreements to Blue Origin, The Boeing Company, Sierra Nevada Corporation, and SpaceX.

¹¹National Aeronautics and Space Administration (NASA) Authorization Act of 2010, Pub.L. No. 111-267, Section 503(2)(2).

Regulation of Crew and Passenger Safety after 2012 Would Add to FAA's Workload

FAA also expects its workload to increase over the next several years as it begins to develop safety regulations for commercial human spaceflight. The Commercial Space Launch Amendments Act of 2004¹² gave FAA the specific responsibility of regulating commercial human spaceflight, but, to allow the industry to experiment and mature, the act allows FAA to regulate crew and passenger safety before 2012 only in response to high-risk incidents, serious injuries or fatalities, or an event that poses a high risk of causing a serious or fatal injury. The FAA Air Transportation Modernization and Safety Improvement Act would extend that date until 8 years after the first licensed commercial launch of a spaceflight participant.¹³ FAA's Associate Administrator for Commercial Space Transportation and an industry association official told us that they expect such a flight to occur within the next 2 years.

Despite this limitation, FAA is responsible for the protection of the uninvolved public, which could be affected by a failed mission that crashes. FAA has interpreted this limited authority as allowing it to regulate crew safety in certain circumstances and has been proactive in issuing a regulation concerning emergency training for crews and passengers.¹⁴ However, FAA has not developed indicators that it would use to monitor the safety of the developing space tourism sector and determine when to step in and regulate commercial human space flight. To allow the agency to be proactive about safety, rather than responding only after a fatality or serious incident occurs, we recommended that FAA identify and continually monitor indicators of space tourism industry safety that might trigger the need to regulate crew and passenger safety before 2012. According to agency officials, FAA has not been able to address our recommendation directly because there have been no launches with passengers. When such launches occur, those same officials told us, they intend to collect and analyze data on safety-related anomalies, safety-critical system failures, incidents, and accidents. However, those officials also told us that they intend to develop a means to share information with and assess lessons learned from the commercial spaceflight industry. Toward this end, the agency has hired a statistician to

¹²Pub.L. No. 108-492, 118 Stat. 3974 (2004).

¹³FAA Air Transportation Modernization and Safety Improvement bill, H.R. 658, recently passed by the House of Representatives.

¹⁴71 Fed. Reg. 75616, December 15, 2006.

develop the architecture for such a data system, according to a senior FAA official.

It is unclear when FAA should or will begin regulating crew and passenger safety, since data for evaluating risk do not exist and proposed legislation would extend the limitation on regulation more than 8 years. Nonetheless, FAA is taking steps that will enable it to be prepared to regulate. Senior FAA officials also told us that FAA is reviewing NASA's human rating of space launch vehicles, as well as FAA's Office of Aviation Safety aircraft certification process as it considers possible future regulations on human spaceflight standards. Furthermore, FAA's Office of Commercial Space Transportation expects to work closely with its industry advisory group—the Commercial Space Transportation Advisory Committee—on the issue. We believe FAA is taking reasonable preliminary steps to regulate crew and passenger safety.

FAA Is Requesting Significantly More Resources to Handle the Expanded Oversight Workload

As a result of the expected increase in responsibilities, FAA is requesting significantly more resources. FAA's fiscal year 2012 budget request would increase the budget for the Office of 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—from 71 full-time equivalent staff in fiscal year 2010 to 103 in fiscal year 2012—as well as a \$5 million increase in obligations on the office's space incentives award program.

Twenty-five of the additional full-time equivalent employees would be part of the anticipated Commercial Spaceflight Technical Center, which is expected to be established in fiscal year 2011 or fiscal year 2012 at the NASA Kennedy Space Center in Florida.¹⁵ FAA expects the center to provide technical support for commercial space launch activities in the areas of spaceflight safety, engineering and standards, launch operations, and space traffic management. The other seven full-time equivalent employees would provide technical expertise in two areas:

- human factors, which is the study of how humans' abilities, characteristics, and limitations interact with the design of the equipment they use, environments in which they function, and jobs they perform; and

¹⁵The establishment of this center is contingent upon funding that NASA would transfer to FAA in fiscal year 2011, according to the Associate Administrator of the Office of Commercial Space Transportation.

-
- human spaceflight.

In past work, we have reported on the difficulty in finding expertise in human factors.¹⁶

In 2006, we raised concerns that FAA's experience in the area of human spaceflight is limited because its launch safety oversight has focused primarily on unmanned launches of satellites into orbit using expendable launch vehicles. As mentioned earlier in my statement, many companies are developing space vehicles of different designs for human spaceflight that are being tested for the first time, requiring that FAA have a sufficient level of expertise to provide oversight. In addition, FAA needs an adequate number of staff to oversee the anticipated growth in the number of launches at various locations. We recommended in 2006 that FAA assess the levels of expertise and resources that will be needed to oversee the safety of the space tourism industry and the new spaceports under various scenarios and timetables. In response to our recommendations, FAA's Office of Commercial Space Transportation hired 12 aerospace engineers. In addition, since our report, FAA has established field offices at Edwards Air Force Base and NASA's Johnson Space Center in anticipation of increased commercial space launches. As test flights expand, there may be the need for FAA to establish additional field offices. In addition, we have reported that as NASA-sponsored commercial space launches increase, FAA's need for regulatory resources and expertise may change, according to industry experts we spoke with.

We believe FAA has taken reasonable steps thus far to ensure that it has adequate resources to fulfill its safety oversight role. The agency's focus on future needs for human factors and human spaceflight expertise seems reasonable given the research and development that the private sector is conducting in human spaceflight and the need for FAA to eventually establish regulations in this area. However, we have not analyzed in depth FAA's budget request for significantly more resources for fiscal year 2012 and there are uncertainties about how fast the demands on FAA's resources will grow.

¹⁶See GAO, *Next Generation Air Transportation System: FAA and NASA Have Improved Human Factors Research Coordination, but Stronger Leadership Needed*, [GAO-10-824](#) (Washington, D.C.: Aug. 6, 2010).

FAA and Industry Face Challenges as the Commercial Space Launch Industry Matures

FAA Safety Regulations May Not Be Suitable for Both Federal Launch Sites and Commercial Spaceports

FAA faces challenges related to regulating commercial spaceports. Specifically, 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 launch sites, will also be suitable for operations at commercial spaceports. We have reported that the safety regulations for expendable launch vehicles may not be suitable for space tourism flights because of differences in vehicle types and launch operations, according to experts we spoke with. Similarly, spaceport operators and experts we spoke with raised concerns about the suitability of FAA safety regulations for commercial spaceports. Experts told us that safety regulations should be customized for each spaceport to address the different safety issues raised by various types of operations, such as different orbital trajectories and differences in the way that vehicles launch and return to earth—whether vertically or horizontally. To address these concerns, we reported that it will be important to measure and track safety information and use it to determine if the regulations should be revised. We did not make recommendations to FAA concerning these issues because the Commercial Space Launch Amendments Act of 2004 required the Department of Transportation (DOT) to commission an independent report to analyze, among other things, whether expendable and reusable vehicles should be regulated differently from each other, and whether either of the vehicles should be regulated differently if carrying passengers. The report, issued in November 2008, concluded that the launch of expendable vehicles, when used to lift reusable rockets carrying crew and passengers, as well as the launch and reentry of reusable launch vehicles with crew and passengers, should be regulated differently from the launch of expendable vehicles without humans aboard.¹⁷ As previously discussed, such rulemaking cannot take place until after December 2012. Similar to our finding, the

¹⁷The Aerospace Corporation, et al., *Analysis of Human Space Flight Safety, Report to Congress* (El Segundo, Calif.: Nov. 11, 2008).

report noted that the development of a data system to monitor the development and actual performance of commercial launch systems and to better identify different launch risk factors and criteria would greatly assist the regulatory process.

Distinguishing FAA's Dual Role of Industry Promotion and Safety

In 2006, we reported that FAA faced the potential challenge of overseeing the safety of commercial space launches while promoting the industry.¹⁸ While we found no evidence that FAA's promotional activities—such as sponsoring an annual industry conference and publishing industry studies—conflicted with its safety regulatory role, we noted that potential conflicts may arise as the space tourism sector develops. We reported that as the commercial space launch industry evolves, it may be necessary to separate FAA's regulatory and promotional activities. Recognizing the potential conflict, Congress required the 2008 DOT-commissioned report to discuss whether the federal government should separate the promotion of commercial human spaceflight from the regulation of such activity. We suggested as a matter for congressional consideration that, if the report did not fully address the potential for a conflict of interest, Congress should revisit the granting of FAA's dual mandate for safety and promotion of human spaceflight and decide whether the elimination of FAA's promotional role is necessary to alleviate the potential conflict. The 2008 commissioned report concluded there was no compelling reason to remove promotional responsibilities from FAA in the near term (through 2012). Moreover, the report noted that the Office of Commercial Space Transportation's estimated resource allocation for promotional activities was approximately 16 percent of the office's budget in fiscal year 2008, which was significantly less than what the office allocated for activities directly related to safety. However, the report noted that the commercial space launch industry will experience significant changes in its environment in the coming decades; therefore, periodic review of this issue is warranted. As we reported in 2009, we still concur with the commissioned report's assessment and see no need for Congress to step in at this time to require a separation of regulatory and promotional activities. However, FAA and Congress must remain vigilant that any inappropriate relationship between FAA and the commercial space launch industry does not occur.

¹⁸In 1984, the Commercial Space Launch Act gave the Department of Transportation the authority to license and monitor the safety of commercial space launches and to promote the industry. Pub.L. No. 98-575, 98 Stat. 3055 (1984).

Integrating Space Transportation into NextGen

NextGen—FAA’s efforts to transform the current radar-based air traffic management system into a more automated, aircraft-centered, satellite-based system—will need to accommodate spacecraft that are traveling to and from space through the national airspace system. As the commercial space launch industry grows and spaceflight technology advances, FAA expects that commercial spacecraft will frequently make that transition and the agency will need tools to manage a mix of diverse aircraft and space vehicles in the national airspace system. In addition, the agency will need to develop new policies, procedures, and standards for integrating spaceflight operations into NextGen. For example, it will have to define new upper limits to the national airspace system to include corridors for flights transitioning to space; establish new air traffic procedures for flights of various types of space vehicles, such as aircraft-ferried spacecraft and gliders; develop air traffic standards for separating aircraft and spacecraft in shared airspace; and determine controller workload and crew rest requirements for space operations. FAA has begun to consider such issues and includes them in a general way in its concept of operations for NextGen.

Maintaining an International Competitive Position for the U.S. Commercial Space Launch Industry

We reported in 2006 that as the commercial space launch industry expands, it will face key competitive issues concerning high launch costs and export controls that affect its ability to sell its services abroad. Foreign competitors have historically offered lower launch prices than U.S. launch providers, and the U.S. industry has responded by merging launch companies, forming international partnerships, and developing lower-cost launch vehicles. For example, Boeing and Lockheed Martin merged their launch operations to form United Launch Alliance, and SpaceX developed a lower-cost launch vehicle. The U.S. government has responded to the foreign competition by providing the commercial space launch industry support, including research and development funds, government launch contracts, use of its launch facilities, and third-party liability insurance through which it indemnifies launch operators.

The continuation of such federal involvement will assist industry growth, according to industry experts that we spoke with. For example, the U.S. government indemnifies launch operators by providing catastrophic loss protection covering third-party liability claims in excess of required launch insurance in the event of a commercial launch incident. Currently, launch operators are required to buy third-party liability insurance for up to \$500 million in addition to insurance for their vehicle and its operations, and the U.S. government provides up to \$1.5 billion in indemnification. Some industry experts have said that government indemnification is important

because the cost of providing insurance for launches could be unaffordable without indemnification. A senior Department of Commerce official told us that without federal indemnification, smaller launch companies may go out of business.

In addition, industry representatives that we interviewed told us that export licensing requirements affect the ability of the U.S. commercial space launch industry to sell launch vehicles abroad. These regulations are designed to establish controls to ensure that arms exports, consistent with national security and foreign policy interests, include launch vehicles because they can deliver chemical, biological, and nuclear weapons. In previous work, a senior Department of Commerce official told us that the U.S. commercial space launch industry had asked Congress to consider changing the statute that restricts space manufacturing items for export. A change in statute would allow for the Departments of State and Defense to review individual items, as they do for other industries.

As the space tourism industry develops, the issue will arise of establishing a foundation for a common global approach to launch safety. According to senior FAA officials, when space tourism operations eventually occur, they are planned to be international, with takeoffs and landings from U.S. commercial spaceports to United Arab Emirates and Singapore spaceports, among others. Thus, the development, interoperability, and harmonization of safety standards and regulations, particularly concerning space tourism flights, will be important for the safety of U.S. and international space operations. In the future, if suborbital point-to-point space travel becomes a reality, entirely new issues will have to be addressed, including bilateral and international interoperability, air and space traffic integration, existing treaty and law implications, national security issues (such as friend or foe identification), customs, international technical standards, and other transportation issues. In response, FAA has established an international outreach program to promote FAA commercial space transportation regulations as a model for other countries to adopt. The outreach program includes establishing initial contacts with interested countries and introductory briefings about FAA regulations.

Lack of an Overarching National Space Launch Strategy

Finally, an overarching issue that has implications for the U.S. commercial space launch industry is the lack of a comprehensive national space launch strategy, which includes issues such as development, procurement, certification, licensing, and regulation of launch vehicles and other aspects of the industry.¹⁹ Numerous federal agencies have responsibility for space activities, including FAA's oversight of commercial space launches, NASA's scientific space activities, the Department of Defense's national security space launches, the State Department's involvement in international trade issues, and the Department of Commerce's advocacy and promotion of the industry. According to the National Academy of Sciences, aligning the strategies of the various civil and national security space agencies will address many current issues arising from or exacerbated by the current uncoordinated, overlapping, and unilateral strategies.²⁰ A process of alignment offers the opportunity to leverage resources from various agencies to address such shared challenges as the diminished space industrial base, the dwindling technical workforce, and reduced funding levels, according to the Academy report. A national space launch strategy could identify and fill gaps in federal policy concerning the commercial space launch industry, according to senior FAA and Department of Commerce officials.

In 2009, we reported on several gaps in federal policy for commercial space launches. For example, we reported that while FAA has safety oversight responsibility for the launch and reentry of commercial space vehicles, agency officials told us that no federal entity has oversight of orbital operations, including the collision hazard while in orbit posed by satellites and debris (such as spent rocket stages, defunct satellites, and paint flakes from orbiting objects). The President's National Space Policy of 2010²¹—which outlines the principles and goals of the United States with regard to its participation in space-related activities—addressed this issue by assigning the Secretary of Defense, in collaboration with the Director of National Intelligence the responsibility for operation of space situational awareness (SSA) capabilities. Through our ongoing work, we

¹⁹GAO has planned work examining the coordination of development, procurement, and certification of launch vehicles.

²⁰Committee on the Rationale and Goals of the U.S. Civil Space Program, National Research Council, *America's Future in Space: Aligning the Civil Space Program with National Needs* (Washington, D.C.: 2009).

²¹Office of the President of the United States of America, *National Space Policy of the United States of America* (Washington, D.C.: June 28, 2010).

have preliminarily found that the Department of Defense has established a program to make SSA data more available and usable for the space community; however, increased participation by commercial and foreign entities, and a way to validate information provided by these entities, is necessary for an effective system of collision awareness.²² One issue that remains unresolved is the role of the National Transportation Safety Board (NTSB) in investigating any accidents that occur. 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. The 2008 DOT-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. Finally, the National Space Policy of 2010 continues to outline a requirement that responsible entities shall promote U.S. commercial space regulations and encourage interoperability with these regulations. Further, it requires that the responsible departments and agencies should minimize, as much as possible, the regulatory burden for commercial space activities and ensure that the regulatory environment for licensing space activities is timely and responsive. Our current work indicates that agencies, such as FAA and NASA, are just beginning the process of addressing this issue as the number of commercial space launches, as well as commercial launches for government customers, is planned to increase in the next several years.

Chairman Palazzo, this concludes my prepared statement. I would be pleased to respond to any questions from you or other Members of the Subcommittee.

GAO Contact and Staff Acknowledgments

For further information on this testimony, please contact Dr. Gerald L. Dillingham at (202) 512-2834 or dillinghamg@gao.gov. Individuals making key contributions to this testimony include Teresa Spisak, Bob Homan, David Hooper, Maureen Luna-Long, Shelby S. Oakley, Andrew Redd, Amy Rosewarne, and Jessica Wintfeld.

²²We plan to issue a report on space situational awareness capabilities in June 2011.

Appendix I: Status of GAO's Recommendations to FAA Concerning Commercial Space Launches

Recommendation	Action taken
The Federal Aviation Administration (FAA) needs to assess the level of expertise and resources that will be needed to oversee the safety of the space tourism industry and the new commercial spaceports under various scenarios and timetables.	FAA has assessed resources and hired additional aerospace engineers. Its most recent assessment calls for a requested 32 additional full-time equivalent staff for the Office of Commercial Space Transportation for fiscal year 2012.
FAA's Office of Commercial Space Transportation should develop a formal process for consulting with the Office of Aviation Safety about licensing reusable launch vehicles.	FAA has not developed a formal process, but the two offices signed a formal agreement for the licensing of SpaceShipTwo, which delineates the responsibilities for each office. Agency officials expect that a similar process will be used as future applications are received.
FAA should identify and continually monitor space tourism safety indicators that might trigger the need to regulate crew and flight participant safety before 2012.	No action has been taken to monitor safety indicators because commercial human spaceflights have not occurred since 2004. The Office of Commercial Space Transportation has, however, consulted on data issues with another FAA office and hired a statistician to begin working on a database architecture, according to a senior FAA official.
FAA should develop and issue guidance on the circumstances under which it would regulate crew and flight participant safety before 2012.	No action has been taken to issue guidance.
As long as it has a promotional role, FAA should work with the Department of Commerce to develop a memorandum of understanding that clearly delineates the two agencies' responsive promotional roles in line with their statutory obligations and larger agency missions.	FAA's Office of Commercial Space Transportation and Commerce's Office of Space Commercialization signed a memorandum of understanding in September 2007. FAA has no agreement with Commerce's International Trade Administration, which also has responsibilities for promoting the commercial space industry and its competitiveness.

Source: GAO.

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