

**GAO**

Testimony

Before the Subcommittee on Aviation,  
Committee on Transportation and  
Infrastructure, House of Representatives

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For Release on Delivery  
Expected at 10:00 a.m. EST  
Wednesday, December 2, 2009

# COMMERCIAL SPACE TRANSPORTATION

## Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles

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



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# Highlights

Highlights of [GAO-10-286T](#), a testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

## Why GAO Did This Study

Since GAO reported on the commercial space launch industry in 2006, 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. The Federal Aviation Administration (FAA) oversees the safety of commercial space launches, licensing and monitoring the safety of such launches and of spaceports (sites for launching spacecraft), and FAA promotes the industry. FAA is also responsible for overseeing the safety of space tourism, but it may not regulate crew and passenger safety before 2012 except in response to high-risk incidents, serious injuries, or fatalities.

This testimony addresses (1) recent trends in the commercial space launch industry, (2) challenges that FAA faces in overseeing the industry, and (3) emerging issues that will affect the federal role. This statement is based on GAO's October 2006 report on commercial space launches, updated with information GAO gathered from FAA, the Department of Commerce, and industry experts in November 2009 on industry trends and recent FAA 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-10-286T](#) or [key components](#). For more information, contact Gerald L. Dillingham at (202) 512-2834 or [dillinghamg@gao.gov](mailto:dillinghamg@gao.gov).

## COMMERCIAL SPACE TRANSPORTATION

### Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles

#### What GAO Found

**Recent Trends.** 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, however, dropped off, and the industry is increasing its focus on space tourism. Since five manned commercial flights demonstrated the potential for commercial space tourism in 2004, companies have pursued research and development and are further developing reusable vehicles for manned flights. Concurrently, companies and states are developing additional spaceports to accommodate anticipated increases in commercial space launches. States have provided economic incentives, and FAA has provided some funding for development.

**Oversight Challenges.** In overseeing the commercial space launch industry, including the safety of space tourism, FAA faces several challenges. These include maintaining a sufficient number of staff with the necessary expertise to oversee the safety of launches and spaceport operations; determining whether FAA's current safety regulations are appropriate for all types of commercial space vehicles, operations, and launch sites; developing information to help FAA decide when to regulate crew and passenger safety after 2012; and continuing to avoid conflicts between FAA's regulatory and promotional roles.

**Emerging Issues.** The U.S. commercial space launch industry is expected to expand as space tourism develops and the National Aeronautics and Space Administration starts to rely on the commercial sector for space transportation. This expansion will affect the federal role. For example, FAA will face increases in its licensing and regulatory workload, and federal agencies and Congress will face decisions about whether to support the U.S. industry by continuing to provide liability indemnification to lower its costs. Additionally, FAA will face policy and procedural issues when it integrates the operations of spacecraft into its next generation air transportation system. 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 agency roles.



Source: Scaled Composites. SpaceShipOne

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Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to testify today on the Federal Aviation Administration's (FAA) oversight of the commercial space launch industry. Historically, commercial space launches carried payloads, generally satellites, into orbit using expendable launch vehicles—that is, vehicles that are only used once. These launches took place primarily at federal launch sites. In recent years, the industry has changed significantly—most notably, the successful launches of SpaceShipOne in 2004 raised the possibility of an emerging commercial space tourism industry that would make human space travel available to the public for the first time. Now, several companies are developing reusable launch vehicles for commercial space tourism and plan to test them within the next few years.<sup>1</sup> In addition, the National Aeronautics and Space Administration (NASA) plans to retire the space shuttle around 2010 and begin using commercial launches to carry cargo and possibly astronauts to the International Space Station. To support an expected growth in commercial space launches, commercial spaceports—which are sites used for launching spacecraft—are being developed by private companies and states. FAA's Office of Commercial Space Transportation is responsible for licensing and monitoring the safety of commercial space launches and spaceports and promoting the industry. The Commercial Space Launch Amendments Act of 2004<sup>2</sup> gave FAA the specific responsibility of regulating commercial human space flight, but, to allow the industry to experiment and mature, the act prohibits FAA from regulating crew and passenger safety before 2012 except 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.<sup>3</sup>

My testimony today focuses on (1) recent trends in the commercial space launch industry, (2) challenges that FAA faces in overseeing the industry, and (3) emerging issues that will affect the federal role. This statement is based on our October 2006 report on commercial space launches<sup>4</sup> and is

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<sup>1</sup>A 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.

<sup>2</sup>Pub. L. No. 108-492, 118 Stat. 3974 (2004).

<sup>3</sup>49 U.S.C. §70105(c).

<sup>4</sup>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).

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updated with information we gathered from FAA, the Department of Commerce, and industry experts in November 2009 on industry trends and recent FAA actions. Our work on the October 2006 report included reviewing FAA's safety oversight processes and interviewing federal government officials and industry representatives to assess FAA's response to emerging industry issues. Appendix I provides an update of the actions that FAA has taken in response to our previous recommendations.

We conducted our work in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Recent Trends in the Commercial Space Launch Industry

To date, the commercial space launch industry has primarily focused on putting payloads, such as satellites, into orbit, using launch vehicles that are used only once. The number of launches for this purpose has, however, dropped off, and the industry appears to be increasing its focus on space tourism. Apart from the five manned flights in 2004, efforts thus far have consisted of tests for research and development purposes, but companies are continuing to develop vehicles for manned flights. Concurrently, companies and states are developing additional spaceports to accommodate anticipated commercial space tourism flights, with states providing economic incentives for development. As part of FAA's mission to promote the commercial space industry, federal funds have also supported infrastructure development at one spaceport.

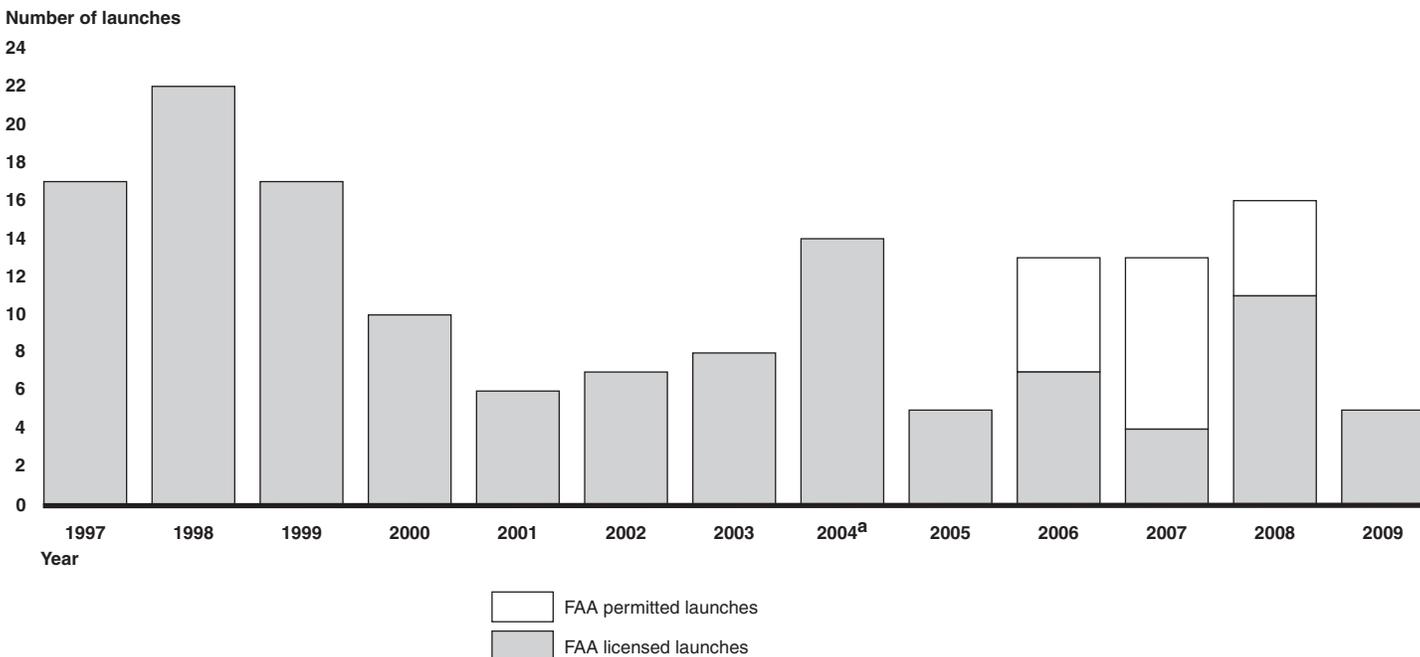
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## Launch Trends

There are three main types of space launches—national security, civil, and commercial. National security launches are by the Department of Defense for defense purposes, and civil launches are by NASA for scientific and exploratory purposes. Commercial launch companies compete domestically and internationally for contracts to carry payloads, such as satellites, into orbit using expendable launch vehicles, which are unmanned, single-use vehicles. Except for the launches of SpaceShipOne in 2004, U.S. commercial space launches have been unmanned. Designed to carry crew and one passenger, SpaceShipOne was the first commercial reusable launch vehicle mission licensed by FAA.

After reaching a peak of 22 launches in 1998 (see fig. 1), the number of commercial space launches began to fluctuate and generally decline following a downturn in the telecommunications services industry, which was the primary customer of the commercial space launch industry. In the last several years, two trends have emerged. First, there has been a drop-off in U.S. commercial orbital launches. In part, this may be because the U.S. commercial space launch industry is not price competitive with foreign companies, some of which receive extensive government support, according to Department of Commerce officials. Second, FAA began issuing experimental permits in 2006 to companies seeking to conduct test launches of reusable launch vehicles. According to industry experts that we spoke with, over the past 3 years 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.

**Figure 1: U.S. Commercial Launches, 1997 to November 2009**



Source: GAO analysis of FAA data.

<sup>a</sup>Includes licensed suborbital launches by Scaled Composites.

Manned commercial space launches took place for the first and only time with the five manned flights of SpaceShipOne in 2004. Although additional

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manned flights were anticipated, they have not materialized since we issued our report in 2006. A number of companies—including Scaled Composites, which is developing SpaceShipTwo—are continuing to develop vehicles for manned flights, but they are not yet developed to a testing stage, which would require a launch license or experimental permit.<sup>5</sup>

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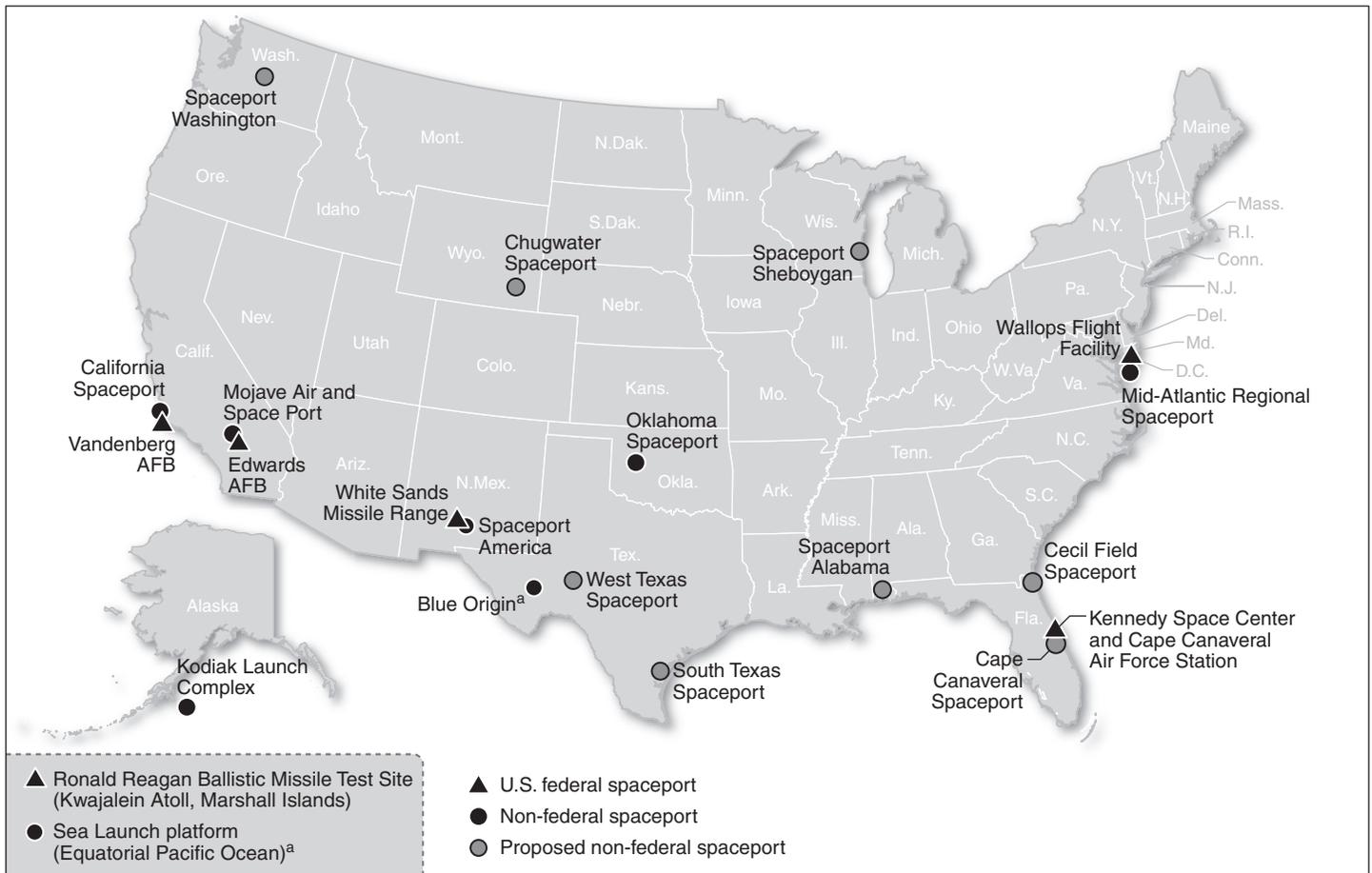
## The Number of Spaceports Is Increasing

Since we reported in 2006, private companies and states are developing additional spaceports to accommodate anticipated commercial space tourism flights and to expand the nation's launch capacity. In 2006, there were six FAA-licensed spaceports and eight proposed spaceports. Since then, one of the proposed spaceports (Spaceport America in New Mexico) has begun operating and one (Gulf Coast Regional Spaceport) has terminated its plans. Two new spaceports in Florida have applied for FAA licenses. Figure 2 shows the existing and proposed spaceports and federal launch sites used for commercial launches.

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<sup>5</sup>FAA 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.

**Figure 2: Existing and Proposed Spaceports in the United States as of November 2009**



Source: FAA and GAO.

<sup>a</sup>Private facility with a sole site operator.

States have provided economic incentives to developers—including passing legislation to decrease liability and lower the tax burden for developers, according to FAA—to build spaceports to attract space tourism and provide economic benefits to localities; FAA has provided funding assistance for infrastructure development. For example, New Mexico provided \$100 million to construct Spaceport America. According to an official from the Oklahoma spaceport, Oklahoma provides approximately \$500,000 annually to the spaceport for operations, and the state paid for the environmental impact statement and the safety analysis needed to apply for an FAA license. The Florida Space Authority, a state agency, invested over \$500 million in new space industry infrastructure

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development, including upgrades to the launch pad, a new space operations support complex, and a reusable launch vehicle support complex. The Mid-Atlantic Regional Spaceport receives half of its funding from Virginia and Maryland, with the remainder coming from revenue from operations. According to FAA, Florida and Virginia also passed bills that grant an exemption from state income tax for either launch services or gains achieved from providing services to the International Space Station. In addition, the Mojave Spaceport in California received an FAA Airport Improvement Program grant of \$7.5 million to expand an existing runway to allow for the reentry of horizontally landing reusable vehicles.

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## Challenges Facing FAA in Overseeing the Commercial Space Launch Industry

FAA faces challenges in ensuring that it has a sufficient number of staff with the necessary expertise to oversee the safety of commercial space launches and spaceport operations. In addition, FAA will need to determine whether its current safety regulations are appropriate for all types of commercial space vehicles, operations, and launch sites. FAA will also need to develop safety indicators and collect data to help it determine when to begin to regulate crew and passenger safety after 2012. Continuing to avoid conflicts between its dual roles as a safety regulator and an industry promoter remains another issue to consider as the space tourism industry develops.

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## FAA Resources and Workload

In 2006, we raised concerns that if the space tourism industry developed as rapidly as some industry representatives suggested, FAA's responsibility for licensing reusable launch vehicle missions would greatly expand. FAA's experience in this area is limited because its launch safety oversight has focused primarily on unmanned launches of satellites into orbit using expendable launch vehicles. Many companies are developing space hardware of different designs that are being tested for the first time, requiring that FAA have a sufficient level of expertise to provide oversight. In addition, FAA has to have an adequate number of staff to oversee the anticipated growth in the number of launches at various locations. We recommended 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, bringing its total staff to 71 full-time employees. 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.

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We believe FAA has taken reasonable steps to ensure that it has adequate resources to fulfill its safety oversight role. However, if the industry begins to expand, as senior FAA officials predict, to 200 to 300 annual launches, a reassessment of FAA's resources and areas of expertise would be appropriate. Moreover, as NASA-sponsored commercial space launches increase, FAA's need for regulatory resources and expertise may change, according to industry experts we spoke with.

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### Suitability of Safety Regulations to Cover Both Federal Launch Sites and Commercial Spaceports

FAA faces the challenge of ensuring 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 spaceports. We 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 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.<sup>6</sup> Similar to our finding, the 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

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<sup>6</sup>The Aerospace Corporation, et al., *Analysis of Human Space Flight Safety, Report to Congress* (El Segundo, Calif.: Nov. 11, 2008).

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greatly assist the regulatory process. FAA has not developed such a data system because so few commercial launches have occurred.

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## Regulation of Crew and Passenger Safety after 2012

Although FAA is prohibited from regulating crew and passenger safety before 2012 except in response to serious injuries or fatalities or an event that poses a high risk of causing a serious or fatal injury, FAA is responsible for the protection of the uninvolved public, which could be affected by a failed mission. 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.<sup>7</sup> 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 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 addressed our recommendation 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. Those officials also told us that they intend to develop a means to share information with and assess lessons learned from the private spaceflight industry.

It is unclear when FAA will or should begin regulating crew and passenger safety, since data for evaluating risk do not exist. A senior FAA official told us that the agency does not plan to issue new regulations even after the 2012 prohibition is lifted and that they would like to see how the current procedures, which require passengers to sign an acknowledgement of informed consent, operates before deciding to issue new regulations. Nonetheless, FAA is taking steps that will enable it to be prepared to regulate. Space tourism companies that we spoke with stated that they now informally collect lessons learned and share best practices with each other and with FAA, which eventually could lead to industry standards. 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 they consider possible future

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<sup>7</sup>71 Fed. Reg. 75616, December 15, 2006.

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regulations on human spaceflight standards. In addition, 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.

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### 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. 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 human space flight 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 space flight 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. We 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 industry—such as was alleged in 2008 between FAA and the airline industry—does not occur with the commercial space launch industry.

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### Emerging Issues

The expected expansion of the U.S. commercial space launch industry due to anticipated events such as the development of space tourism and the retirement of NASA's space shuttle and the agency's shift to using the

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commercial sector to provide space transportation will affect the federal role in various ways such as increasing FAA's licensing and regulatory workload. To assist in the expansion of the industry, other issues will emerge for federal agencies and Congress to consider, such as whether to assist the industry in lowering costs by extending existing liability indemnification and how to enhance the global competitiveness of the U.S. industry. Another issue that will emerge as the industry grows is how FAA will integrate space flights with aircraft traffic as part of efforts to develop the next generation air transportation system (NextGen). A national space launch strategy, which is currently lacking, could provide a cohesive framework for addressing such issues and establishing national priorities.

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## Expected Industry Expansion

Industry experts that we spoke with and senior officials at FAA expect that the number of commercial space launches will increase over the next several years because of the continued development of vehicles for human space flight and in response to prize competitions. Starting in the next 3 to 5 years, senior FAA officials expect several companies to begin offering paying customers the opportunity to fly onboard suborbital space flights,<sup>8</sup> with numerous launches taking place each year. Virgin Galactic is among the companies that are undertaking research and development for launch vehicles designed to serve the anticipated space tourism market. FAA reported in 2008 that the company had sold 250 seats for its flights. Scaled Composites and Virgin Galactic formed a joint venture to develop SpaceShipTwo for Virgin Galactic. Other companies, such as XCOR Aerospace and Armadillo Aerospace, have announced plans to develop vehicles to serve the personal spaceflight market. In addition, prize competitions are expected to spur the growth of the space launch industry. For example, the Northrop Grumman Lunar Lander Challenge featured \$1.65 million in prizes for vehicles that can simulate the liftoff and landing of a lunar spacecraft; prizes were awarded to Masten Space Systems and Armadillo Aerospace in November 2009. Both companies told us that they intend to apply for FAA experimental permits soon. In addition, the \$30 million Google Lunar X PRIZE is offered to those who can safely land a robot on the surface of the moon, travel 500 meters, and send video images and data to earth by December 2014. Such competitions

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<sup>8</sup>A 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.

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spur research and development and require FAA licensing or permitting to ensure the safety of the uninvolved public.

Senior FAA officials also expect the agency's licensing and oversight responsibilities to increase as NASA begins to rely on foreign partners and private industry to deliver cargo, and eventually crewmembers, to the International Space Station after it retires the space shuttle in 2010 or shortly thereafter. Two companies—SpaceX and Orbital Sciences—have received NASA contracts to develop new launch vehicles that will service the International Space Station. According to FAA officials and industry experts, test flights for the new vehicles are expected to begin next year with SpaceX at the beginning of the year and Orbital Sciences near the end of the year. FAA is working with SpaceX on its launch license application and Orbital Sciences is in the pre-application phase. FAA has established a field office at the Johnson Space Center in response to the anticipated increase in launches.

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### 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, industry players have called for the continuation of indemnification to support U.S. competitiveness. Indemnification secures another party against risk or damage. 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. The law that allows for indemnification expires in

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December 2009.<sup>9</sup> Some industry experts have said that it is important that the law be extended because the cost of providing insurance for launches could be unaffordable without indemnification. According to a space insurance expert, as there has not been an incident requiring the U.S. government to pay out third-party claims, the cost to the government of providing indemnification has been only for administrative purposes. Nonetheless, according to a senior Commerce official, there is always a possibility of a launch mishap that could invoke indemnification. FAA has asked for the law's extension as a means to promote the growth of the industry, and the Department of Commerce supports this position. A senior 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 its services abroad. These regulations are designed to establish controls to ensure that arms exports are consistent with national security and foreign policy interests include launch vehicles because they can deliver chemical, biological, and nuclear weapons. A senior Department of Commerce official told us that the U.S. industry has 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, space tourism operations are planned to be international, with takeoffs and landings from U.S. 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

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<sup>9</sup>49 U.S.C. §70113(f).

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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.

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### 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 space flight 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 space flight 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 has developed a concept of operations document.

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### Lack of an Overarching National Space Launch Policy

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, according to federal officials and industry experts. 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.<sup>10</sup> A process of

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<sup>10</sup>Committee 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).

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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 Commerce officials.

Our research has identified several gaps in federal policy for commercial space launches. For example, while FAA has safety oversight responsibility for the launch and re-entry 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). Another issue that has not been resolved 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.<sup>11</sup> The 2008 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. According to senior officials we spoke with at FAA and Commerce, the need for an overall U.S. space launch policy that includes commercial space launches is being discussed within DOT and across departments, as part of the administration's review of national space activities, but the development of a national policy has not yet begun.

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

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<sup>11</sup>S. 2768, 111<sup>th</sup> Congress (2009), would give NTSB authority to investigate accidents involving commercial space launch vehicles.

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## GAO Contact and Staff Acknowledgments

For further information on this testimony, please contact Dr. Gerald L. Dillingham at (202) 512-2834 or [dillingham@gao.gov](mailto:dillingham@gao.gov). Individuals making key contributions to this testimony include Teresa Spisak, Maureen Luna-Long, Rosa Leung, Erica Miles, David Hooper, and Elizabeth Eisenstadt.

# Appendix I: Status of GAO's Recommendations to the Federal Aviation Administration 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 spaceports under various scenarios and timetables.	FAA has assessed resources and hired 12 additional aerospace engineers.
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 on monitoring safety indicators because commercial human space flights have not occurred since the SpaceShipOne launches in 2004. When commercial human space flights occur, FAA plans to monitor key safety indicators including safety-related anomalies, safety-critical system failures, incidents, and accidents. FAA officials plan to track these indicators, precursors, trends, or lessons learned that would warrant additional FAA regulation.
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. However, senior FAA officials say that the agency has held internal discussions on the circumstances under which it would regulate crew and space flight participant safety before 2012 in the event of a casualty or close call. The officials noted that launch vehicle operators are required to report to FAA mishaps and safety-related anomalies and failures and take appropriate corrective actions prior to the next launch.
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' respective 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.

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