

## THE ORIGIN AND PRACTICE OF U.S. COMMERCIAL HUMAN SPACE FLIGHT REGULATIONS

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### Abstract

The commercial human space flight regulatory regime in the United States is the result of deliberate reasoned policy choices by the federal government. The regulations and the legislation that spawns them are the outgrowth of American air and space flight history. They are also the result of the government's belief that private enterprise has the acumen, will, and technical ability to make commercial human space flight a successful independent business. This paper illustrates the pioneering evolution of the commercial human space flight regulatory regime in the United States and highlights the Federal Aviation Administration's current role in the commercial space transportation industry. The commercial space industry is young, as are its regulatory overseers, and evolutions in technology and operations will occur. The FAA will track those developments and make course corrections as necessary, ever mindful of the capabilities and limitations of the industry, while still fulfilling its Congressional mandates.

### 1. Introduction:

Commercial space transportation in the United States began in the 1980s as government vehicles were privatized and new companies recognized business opportunities. To protect public safety, the U.S. government created a single agency authority in 1984 in the Department of Transportation under the Commercial Space Launch Act. Regulatory responsibility and promotion authority was given to the Office of Commercial Space Transportation, which is now within the Federal Aviation Administration (FAA). Although the law was originally enacted to regulate expendable launch vehicle operations and non-federal launch site operations, the FAA and the Congress have been proactive in responding to the growth of the commercial space transportation industry by expanding the law and its implementing regulations, to cover the emergence of reusable launch vehicles and private human space flight. This paper will detail regulatory approaches taken by the U.S. Government from its past and present including the landmark 2004 Commercial Space Launch Amendments Act and its implementation. The paper will

also identify future challenges for both the U.S. and global community as the commercial space transportation industry continues to evolve.

## 2. Historical U.S. Aviation Analog

From aviation barnstormers to commercial spaceships, the FAA and its predecessor organizations have evolved cutting edge technology and milestone regulatory approaches. It is helpful to briefly review the history of U.S. aviation and the development of its associated regulatory framework as an analog to the commercial space transportation industry and regulatory process.

On December 17, 1903, the Wright Brothers made aviation history by conducting the first sustained and controlled powered manned flight,<sup>1</sup> but two decades would pass before federal legislation installed a regulatory framework for aviation. In the interim, aviation moved ahead in an uneven process of trial and error. In May of 1908, Charles Furnas, a mechanic for the Wrights, became the first airplane passenger. That same year, Lt. Thomas Selfridge, flying as a passenger, became the first fatality in aviation history. Orville Wright, the pilot that day, survived with serious injuries. Just two months earlier, the community of Kissimmee, Florida had adopted a municipal ordinance dealing with limits of flights and annual licensing, perhaps the first example of aviation legislation.<sup>2</sup>

Unregulated flight continued. In 1911, Calbraith Rodgers had completed the first U.S. transcontinental series of flights. Beginning in Long Island, Rodgers traveled 3,390 miles over the course of 49 days, crashing some 15 times. Due to the excessive amount of crashes and the resulting repairs, only one strut and the rudder remained of the original equipment upon arrival in Pasadena, California. By 1912, the Wright Company had been incorporated; the first airmail legislation had

been introduced, and the first air mail experiments had been flown. It was in April of 1912 that Connecticut adopted the Connecticut State Air Regulation, becoming the first state to enact legislation.<sup>3</sup> It is interesting to note that the first U.S. activities regulating aviation were actually municipal and state actions.

The first regular, U.S. domestic air-passenger service started on New Year's Day in 1914. The St. Petersburg-Tampa Airboat Line offered service across the 21 mile distance between its two namesake cities in just 23 minutes. Flying two-seater Benoist XIV flying boats, the operation could only take one passenger per trip, although "occasionally a second passenger sat in the lap of the first." The fee was five dollars. A second plane was acquired, this one equipped to carry two passengers. Although the airboat line only stayed in business four months, they flew some 1,205 passengers 11,000 miles.<sup>4</sup>

### 2.1. Federal Organization Steps and Laws

The National Advisory Committee for Aeronautics (NACA) was established by an act of Congress in 1915. President Wilson personally appointed the first Committee members who were tasked with investigating the problems associated with flight and how those problems might be addressed. But it was not until ten years later that President Coolidge signed the Kelly Act.<sup>5</sup> The Kelly Act transferred supervision of the domestic air mail from the Post Office and turned it over to private industry. The Act laid the groundwork for a robust air transportation industry as it, through mail contracts, provided the private companies with a means to earn revenue. This allowed them to develop their passenger and cargo business. In the fall of the same year, President Coolidge created the President's Aircraft Board (often called the Morrow Board). The Board was tasked to "recommend a U.S. air policy related to the development of aircraft as primary vehicles of peaceful air commerce."<sup>6</sup>

The 1920s saw a proliferation of barnstormers with the return of World War I fliers to America and widely available surplus planes. There were almost no safety regulations at any government level. Flying for entertainment was popular. By 1926, the aviation industry was demanding federal legislation to improve and maintain safety standards so the airplane's full commercial potential could be reached.

The May 1926 Air Commerce Act was the cornerstone of the Federal government's regulation of civil aviation. "The Act charged the Secretary of Commerce with fostering air commerce, issuing and enforcing air traffic rules, licensing pilots, certificating aircraft, establishing airways, and operating and maintaining aids to air navigation."<sup>7</sup> The Department of Commerce certified pilots and aircraft, built a system of lighted airways (taking over for the Post Office Department), improved radio communications and introduced beacons for air navigation.<sup>8</sup>

Another noteworthy historical milestone also occurred in 1926 with the establishment of the Guggenheim Foundation. The Daniel Guggenheim Fund for the Promotion of Aeronautics was created to "awaken the American public to the potentialities of commercial aviation," funding a safe aircraft competition, establishing collegiate programs in aeronautical engineering, and funding the development of flight by instrument. The Foundation, with its \$2,500,000 fund, is an example of private involvement to advance aviation.<sup>9</sup> Similar private activities would surface in the commercial space transportation industry in the coming years.

### 2.2. Lindbergh's Flight and Growth of Aviation

Several milestones and aviation "firsts" would be recorded as the industry advanced. Particularly significant is the first transatlantic nonstop solo flight conducted by Charles Lindbergh from Long Island to Paris in 1927. Historians hold that

Lindbergh's flight in pursuit of the \$25,000 Orteig Prize captivated public interest and ignited a major aviation boom. Despite Lindbergh's achievement, the first commercial nonstop transatlantic service did not occur for another 28 years.<sup>10</sup>

At the time of Lindbergh's flight, there were only 30 planes in America that could be considered airliners, offering a total 200 seats.<sup>11</sup> But from 1932 to 1940, the number of airplane miles flown in the United States grew from 45 million to 120 million miles while the number of passengers increased from about 474,000 to 2.9 million.<sup>12</sup>

### 2.3. The Civil Aeronautics Act, Chicago Convention, and Birth of the FAA

With the Civil Aeronautics Act of 1938, federal civil aviation responsibilities were transferred from the Department of Commerce to the newly created Civil Aeronautics Authority (CAA). The government was also empowered to determine air carrier routes and regulate airline fares. President Roosevelt sent the CAA back to the Department of Commerce and split it into two parts. The surviving CAA was given responsibility for air traffic control, safety enforcement and aircraft certification while a new Civil Aeronautics Board (CAB) was given the jobs of accident investigation, rulemaking for safety and airline economic regulation.<sup>13</sup>

The United States invited 55 nations/aviation authorities to a conference in Chicago in 1944 that created the International Civil Aviation Organization (ICAO), known as the Chicago Convention. With agreement by 32 nations, ICAO was established to reach levels of uniformity in international aviation. According to an ICAO history summary, "[t]he most important work accomplished by the Chicago Conference was in the technical field because the Conference laid the foundation for a set of rules and regulations regarding air navigation as a whole which brought safety in flying a great step forward and paved the way for the application of a

common air navigation system throughout the world.”<sup>14</sup>

In the U.S., after a series of midair collisions and general recognition of the approaching passenger jet era, Congress created the Federal Aviation Agency (FAA) with the Federal Aviation Act of 1958. The FAA replaced the CAA and centralized a common civil-military air navigation and air traffic control system while taking safety rulemaking away from the CAB.<sup>15</sup> With the establishment of a presidential cabinet level Department of Transportation (DOT) in 1966, the FAA became part of DOT and its name was changed to the Federal Aviation Administration in 1967. Economic regulation of the airlines stopped with the passage of the Airline Deregulation Act of 1978, which marked the beginning of the end of the CAB. It was eliminated in 1984.

### 3. The Origin of U.S. Commercial Space Transportation Regulations

Unlike aviation, space transportation began as a government-run endeavor, because of its high development cost and strategic importance. While commercially operated satellites had been around since 1965, it was not until the 1980s that space launch operations moved into the commercial realm in the United States. One of the key policy themes of the Reagan Administration was to privatize applicable government activity. The 1982 National Space Policy stated that the government “encourages domestic commercial exploration of space capabilities, technology, and systems for national economic benefit” and that the government will “...provide a climate conducive to expanded private sector investment and involvement in civil space activities, with due regard to public safety and national security. Private sector space activities will be authorized and supervised or regulated by the government to the extent required by treaty and national security.”<sup>16</sup>

With U.S. expendable launch vehicles scheduled to be phased out from government service and payloads shifted to the new Space Shuttle, private companies saw opportunities to compete with the Shuttle and Europe’s Ariane launch vehicle to launch communications and other satellites. Arianespace penetrated the U.S. market when GTE Spacenet signed a contract to launch on an Ariane rocket in 1982. Furthermore, the stage was set for a new approach to commercial space launch after the bureaucratic difficulties encountered by Space Services Incorporated. The privately funded Space Services had to go through 18 different U.S. government agencies and 22 different federal statutes to conduct a commercially operated suborbital test launch.<sup>17</sup> The successful launch occurred in September 1982 from the Texas coast.

In May 1983, a presidential directive declared that the U.S. government would endorse and facilitate commercial operation of existing and new expendable launch vehicles (ELVs) by the private sector. The directive stated that the government would license, supervise and/or regulate operations only to the extent required to meet national and international obligations and to ensure public safety. It also said the government would encourage use of its national launch ranges but would not subsidize commercial ELVs.<sup>18</sup> Later that year in November, President Reagan designated the Department of Transportation (DOT) as the lead agency for commercialization of ELVs. The Department of Commerce campaigned hard for leadership but DOT successfully argued that ELVs were a mode of transportation and that regulation and promotion were similar to duties performed at that time by the Federal Aviation Administration, which was part of DOT.<sup>19</sup>

#### 3.1. Establishment of a U.S. Regulatory Authority

In February 1984, the president signed Executive Order 12465, which formalized the role of DOT and instructed it to promote and encourage the development of

commercial ELV activities. The order directed the Secretary of Transportation to identify federal statutes, treaties, regulations and policies that may have adverse impact on ELV commercialization efforts.<sup>20</sup> DOT Secretary Elizabeth Dole established the Office of Commercial Space Transportation (OCST) to carry out the Executive Order. Meanwhile, the United States Congress decided to legislate governmental oversight of commercial space transportation by statute,<sup>21</sup> passing the Commercial Space Launch Act (CSLA, public law 98-575) which was signed by President Reagan on October 30, 1984.<sup>22</sup>

The law, amended since 1984, set forth the following responsibilities: “the Secretary of Transportation is to oversee and coordinate the conduct of commercial launch and reentry operations, issue and transfer commercial licenses authorizing those operations, and protect the public health and safety, safety of property, and national security and foreign policy interests of the United States.”<sup>23</sup>

The law also said that “the United States should encourage private sector launches, reentries, and associated services and, only to the extent necessary, regulate those launches, reentries, and services...”<sup>24</sup> One purpose in the law is to “promote economic growth and entrepreneurial activity.”<sup>25</sup> Applicants for a launch license would only have to go to one government agency: the Department of Transportation. Once DOT determined it had received an application complete enough to review, the law allowed 180 days to act on it. DOT would also be in charge of licensing the operation of non-federal launch sites (often referred to as commercial spaceports).

Passage of the law and subsequent regulations produced a significant change from U.S. government operated missions. For a commercial launch, in addition to U.S. policy and security interests, DOT would license the “launch event” for public safety reasons. The government would not oversee

whether the vehicle’s mission was successful. That was left as the responsibility of the commercial launch operator. In addition, the FAA would not “certify” a launch vehicle, in contrast to commercial airplanes that carry people for hire. For commercial space launch, the FAA would focus on the ability of an operator to carry out a safe launch.

To advise the government, a Commercial Space Transportation Advisory Committee (COMSTAC) was established by DOT in 1984. COMSTAC is comprised of representatives from launch, satellite, insurance, legal and financial companies as well as academia. The committee provides input to the government regarding the growth and development of the industry including removal of regulatory barriers.

The Office of Commercial Space Transportation was transferred from a staff office directly under the DOT Secretary to the Administrator of the Federal Aviation Administration in 1995 where responsibility was delegated to the Associate Administrator for Commercial Space Transportation (AST).

### 3.2. Amendments and Evolution

Over the years, the 1984 law has been amended. Indemnification provisions were added in 1988 to ensure commercial parity with international competitors. Indemnification meant the government would potentially provide catastrophic loss protection for a successful liability claim against a launch provider.<sup>26</sup> The FAA licensed the launch of METEOR (previously known as COMET), a spacecraft which was to return a payload to Earth (the launch failed in 1995). Congress eventually gave the FAA jurisdiction and licensing responsibility over commercial reentry and reentry sites in 1998 while extending conditional indemnification to reentry vehicle operators.<sup>27</sup> Based on guidance and authority in the Commercial Space Act of 1998, in 2000, the FAA addressed indemnification concerns and issued

Reusable Launch Vehicle (RLV) and reentry licensing regulations. These regulations specified requirements for obtaining a license to launch and reenter an RLV, reenter a reentry vehicle (a vehicle that is not an RLV), and operate a reentry site. Congress did not specifically address human space flight at that time. Congress also did not grant DOT authority over commercial space transportation within space itself, otherwise referred to as “on-orbit authority.”

As RLV developers progressed in the early 2000s and market interests began to shift from launching satellites to carrying people, it became clear to industry that more certainty was needed in legal and regulatory regimes to provide assurances for financial backers. Congress, the FAA, and industry perceived the need to address a number of issues to firmly remove ambiguities regarding private human space flight. These included: what office within the FAA would have authority over “hybrid” vehicles (or combinations of vehicles) that had characteristics of both airplanes and rockets? What was the definition of a suborbital rocket? What was the extent of FAA jurisdiction over human space flight, and what kind of liability and indemnification protection would there be for passengers, crew and third parties? Was there a better way to do experimental flight testing without having to get a full launch license?<sup>28</sup>

#### 4. 2004: The Year That Changed Everything

The pivotal year for commercial space transportation, 2004, saw Scaled Composites’ historic *SpaceShipOne* flights in pursuit of the Ansari X PRIZE. The 10 million dollar prize was awarded to the first company to privately build and fly a reusable spaceship to an altitude of 100 kilometers, and then repeat the flight within two weeks using the same vehicle. It was a historic year for FAA as result of AST’s involvement in licensing *SpaceShipOne* flights and with the passage of the Commercial Space Launch Amendments Act of 2004.

On April 1, 2004, AST granted the world’s first license for a commercial, suborbital, piloted, rocket launch to Scaled Composites, LLC.<sup>29</sup> For this mission-specific license, AST authorized Scaled Composites to conduct up to six piloted missions with *SpaceShipOne*, from Mojave, California. Under this license, “launch” commenced upon rocket motor ignition. Prior to ignition, when *SpaceShipOne* was carried to release altitude by the *White Knight* aircraft and released, operations were not conducted under the license. The *White Knight* aircraft operated under an FAA Special Airworthiness Certificate in the Experimental Category.<sup>30</sup>

After two rocket powered flights of *SpaceShipOne* under an FAA license, Mojave Aerospace Ventures (a joint company between Scaled Composites and financier Paul Allen) was ready to attempt a launch into space. For purposes of the competition, the X PRIZE Foundation considered space to begin at 100 kilometers.

On June 21, 2004, Mike Melvill of Scaled Composites, piloted *SpaceShipOne* to 328,491 feet (about 62 miles or 100 kilometers), making history by becoming the first civilian to fly a private spaceship to space. He was also the first private pilot to earn FAA commercial astronaut wings, which were presented by AST.<sup>31</sup> Later that same year on September 29 and October 4, pilots Mike Melvill and Brian Binnie, respectively, piloted *SpaceShipOne* to space and back, winning the coveted Ansari X PRIZE. While Mojave Aerospace Ventures won the prize, a total of 26 teams from 7 countries competed resulting in multiple technology approaches and further propelling the commercial space industry.<sup>32</sup>

Many have compared the historic *SpaceShipOne* flights with that of Lindbergh’s transatlantic flight regarding the pursuit of a prize and the resultant flare in public interest. In the days and months that followed the prize winning flights, there was

a surge of media and public attention devoted to commercial space transportation. Some companies immediately turned their attention to making a business out of flying people into space.

On June 17, 2004, AST issued East Kern Airport District a launch site operator license for Mojave Airport, California, making it the nation's first commercial inland spaceport. Mojave Air and Space Port also claimed the title of the first FAA-licensed launch site authorized to conduct suborbital reusable launch vehicle missions.

#### 4.1. The First Law for Commercial Human Space Flight

Before the close of 2004, President Bush signed the Commercial Space Launch Amendments Act (CSLAA) of 2004, into law. This action, executed on December 23, was a pivotal moment in U.S. commercial space transportation regulatory history.<sup>33</sup> The significance of the CSLAA to the commercial space industry can be illustrated by highlighting four main areas of the Act.

The first words of the Act state its purpose: "to promote the development of the emerging commercial human space flight industry..."<sup>34</sup> This placed both Congress and the Executive Branch on the record to support that goal.

The CSLAA recognized that U.S. companies are developing space vehicles intended to carry humans. As a result, the CSLAA clarified the FAA's responsibility for regulating commercial human space flight.<sup>35</sup> However, the CSLAA also limited the extent to which AST could regulate the safety of persons onboard until 2012. The Act instructed the FAA that the "regulatory standards governing human space flight must evolve as the industry matures so that regulations neither stifle technology development nor expose crew or space flight participants to avoidable risk..." Also, the term "space flight participant" was introduced to characterize non-crew members on board. The term "passenger"

was avoided as these individuals will be significantly more aware of the risks and undergo substantial training that is well above the basic requirements of a commercial airline passenger. The CSLAA mandates that space flight participants provide informed consent.<sup>36</sup>

The CSLAA allows individuals to fly at their own physical and financial risk. While conditional indemnification was extended by the government to cover the operators of human space flight vehicles under an FAA license (but not for those operators authorized under the new experimental permit), space flight participants were excluded from eligibility for indemnification. However, "... nothing prevents a licensee or operator from adding individual space flight participants as additional insurance under its liability policy."<sup>37</sup>

#### 4.2. Experimental Permits

The CSLAA created the experimental permit regime and instructed AST to model it after the airworthiness regime of experimental aircraft. Experimental permits were designed for the launch of developmental reusable suborbital rockets on suborbital trajectories.<sup>38</sup> An experimental permit is a voluntary alternative option to the mandatory requirement for a license. Under an experimental permit, applicants are required to meet one or more of the following criteria to be eligible for a permit: "...research and development to test new design concepts, new equipment, or new operating techniques; showing compliance with requirements as part of the process for obtaining a license under this chapter; or crew training prior to obtaining a license for a launch or reentry using the design of the rocket for which the permit would be issued."<sup>39</sup>

There are some noteworthy differences between experimental permits and licenses, as listed in a 2008 FAA report:

- The FAA must determine whether to issue an experimental permit within 120

days of receiving an application. For a license, it is 180 days.

- Under a permit, a reusable suborbital rocket may not be operated to carry property or human passengers for compensation or hire. No such restriction applies for a license.

- Damages arising from a permitted launch or reentry are not eligible for “indemnification,” the provisional payment of claims under Chapter 701. Damages caused by licensed activities, by contrast, are eligible for the provisional payment of claims to the extent provided in an appropriation law or other legislative authority.

- A permit must authorize an unlimited number of launches and reentries for a particular reusable suborbital rocket design. Although a license can be structured to authorize an unlimited number of launches, no statutory mandate to do so exists.

- Under a permit, a launch operator is not required to demonstrate that the risk from a launch falls below specified quantitative criteria for collective and individual risk. Under a license, a launch operator must.

- Under a permit, a launch operator is not required to have a separate safety organization or specific safety personnel. Under a license, a launch operator must.”<sup>40</sup>

## 5. AST Mission, Organization and Commercial Launch Activity to Date

AST’s mission is: “To ensure protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch or reentry activities, and to encourage, facilitate, and promote U.S. commercial space transportation.”<sup>41</sup>

### 5.1 AST Organization

AST plays a crucial role in the U.S. commercial space transportation industry issuing licenses and experimental permits for launch, reentry and site operators. AST

performs related compliance monitoring and safety inspection functions. AST can also issue safety approvals for specific elements or processes pertaining to a commercial launch operation.

With a total authorized staff of 67 people, AST is led by the Associate Administrator for Commercial Space Transportation, who reports to the FAA Administrator. The office, located in Washington, DC, is comprised of three divisions and one field office in Florida. The three divisions are:

- AST-100: Space Systems Development Division, which conducts environmental analysis, interagency and international policy, promotion and outreach, industry advisory relations, industry trade analysis and forecasting, research and development management, initial consultations with prospective license and permit applicants, and is developing approaches for space traffic management;
- AST-200: Licensing and Safety Division, which issues licenses for commercial space launches and reentries and the operation of non-federal space launch sites and reentry sites. AST-200 also determines insurance or other financial responsibility requirements for commercial launches and reentries and leads compliance monitoring and safety inspections; and
- AST-300: Systems Engineering and Training Division, which develops safety standards and issues experimental permits for reusable suborbital rockets and safety approvals. It is also responsible for developing safety tools and analysis, and for delivering training to AST personnel.

The field office, known as AST-20, the Commercial Space Transportation Safety Office at Patrick Air Force Base, supports U.S. Air Force and FAA integration through coordination with Air Force staff to ensure safe operations for commercial space launch activities.

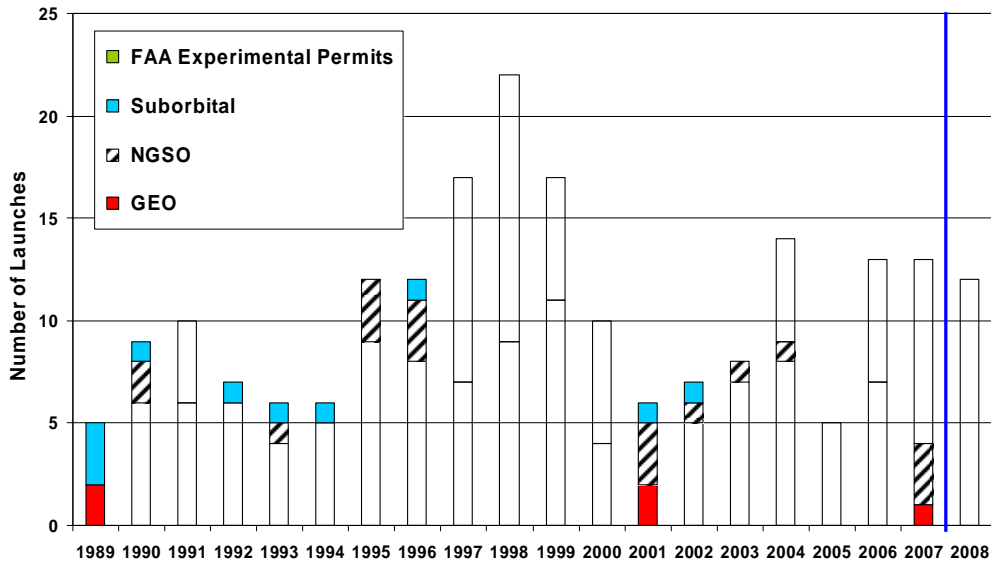


5.2. Launches to Date and Launch Sites

The first commercial launch licensed by DOT took place in 1989. By August 2008, over 190 launches have been licensed without any loss of life or significant property damage to the public. Two companies have opted to exercise experimental permits to date. Six permit flights took place in 2006 and 9 flights occurred in 2007.

Six non-federal launch site operators have been licensed by FAA. The sites are located within the states of California, Florida, Virginia, Alaska and Oklahoma and more locations are in development. Many spaceports are funded by state governments seeking to attract commercial business.

The chart below illustrates the amount and types of FAA-licensed and permitted launches from 1989-2007, with an estimate for 2008.



NGSO – non-geosynchronous orbits GSO – geosynchronous orbit  
 Source: Federal Aviation Administration, February 2008

ensure its success while at the same time adhering to the mission of protecting public safety. A report to Congress required by the CSLAA on human space flight safety issues is to be submitted by December 23, 2008.

The following includes some examples of FAA’s facilitation of industry. In 2007, the FAA conducted a research and development project to study what duty and rest periods should be for crew of a launch or reentry vehicle. In 2008, the FAA released a “Commercial Human Spaceflight Crew Training Survey” of organizations that offer training resources in the U.S.<sup>42</sup>

Integration of air and space vehicle traffic is an activity the FAA has been working on since the 1990s. As part of U.S. efforts to manage future air traffic growth, in 2008, AST released “Space Transportation Concept of Operations Annex for NextGen Version 1.0.”<sup>43</sup> The document is intended as a guide for the transformation of U.S. air

6. Future Activity and Challenges

The FAA is proactively working on issues to keep pace with the developing industry to

and space transportation operations and infrastructure toward an integrated national transportation system under the Next Generation Air Transportation System. The

FAA recognizes that with more frequent space operations, an equitable balance will need to be achieved for all users of the national airspace.

### 6.1. Challenges Ahead

Other challenges await both the FAA and the international community as the commercial space transportation industry grows and evolves. Some challenges involve international policy and legal issues. Other challenges involve the balance of commercial and government needs and some involve advances in technology.

Some future challenges are:

- Integration of space and air traffic internationally;
- Increased volume of regional suborbital space traffic and integration with aircraft and airports during a transition to regular space operations;
- Harmonization of international space travel regulations;
- The need for on-orbit authority of U.S. commercial operations;
- Laws and policies in space for private citizens, companies;
- Regulation of point-to-point and/or intercontinental space travel;
- Medical issues for orbital space flight participants and crew;
- Export policies and International Traffic and Arms Regulations (ITAR);
- Applicability of international treaties and agreements to commercial activity;
- Future safety circumstances that may warrant additional FAA regulations such as in-flight anomalies of safety critical systems or accidents;
- The potential need for FAA regulations for design or operation of a launch vehicle after 2012 to protect the health and safety of crew and space flight participants;<sup>44</sup> and
- How to regulate beyond informed consent if necessary for future crew and space flight participants.

## 7. Conclusion

The regulatory history thus far suggests that change is a continual part of commercial space transportation. Private human space flight is likely to feature similar changes as the industry evolves towards new markets with new technologies and experiences the restless innovation of entrepreneurs. The FAA Office of Commercial Space Transportation expects to make course corrections as necessary, ever mindful of its mission to encourage, facilitate and promote the industry while maintaining its commitment to public safety.

## Endnotes

<sup>1</sup> “Handbook of Airline Statistics,” Civil Aeronautics Board, 1969, page 423.

<sup>2</sup> *Ibid.*, page 423-424.

<sup>3</sup> *Ibid.*, page 424. Regarding Connecticut State Air Regulation, some sources credit June 8, 1911 over April 1912.

<sup>4</sup> *Ibid.*

<sup>5</sup> Also called the Contract Air Mail Act of 1925.

<sup>6</sup> “Handbook of Airline Statistics,” Civil Aeronautics Board, 1969, page 427.

<sup>7</sup> Federal Aviation Administration, 2000, <http://www.faa.gov/about/history/>

<sup>8</sup> *Ibid.* The roots of regulating transportation in the U.S. go back to the 1887 Interstate Commerce Act, originally focused on railroads.

<sup>9</sup> “Handbook of Airline Statistics,” Civil Aeronautics Board, 1969 edition, page 427.

<sup>10</sup> “Handbook of Airline Statistics,” Civil Aeronautics Board, 1969 edition, page 427.

<sup>11</sup> Heppenheimer, T.A., “Turbulent Skies: The History of Commercial Aviation,” John Wiley & Sons, 1995, page 14.

<sup>12</sup> “Aware of the Hazards,” remarks by Patricia Grace Smith, FAA Associate Administrator for Commercial Space Transportation, given at the International Association for the Advancement of Space Safety conference, Chicago, Illinois, May 14, 2007, page 3.

<sup>13</sup> Federal Aviation Administration, 2000, <http://www.faa.gov/about/history/>

<sup>14</sup> International Civil Aviation Organization, [http://www.paris.icao.int/history/history\\_1944.htm](http://www.paris.icao.int/history/history_1944.htm)

<sup>15</sup> Federal Aviation Administration, 2000, <http://www.faa.gov/about/history/>

<sup>16</sup> “National Space Policy,” National Security Decision Directive 42, The White House, July 4, 1982.

<sup>17</sup> Congressional Record, 1984, page S-13888.

<sup>18</sup> “Commercialization of Expendable Launch Vehicles,” National Security Decision Directive 94, The White House, May 16, 1983.

<sup>19</sup> “Exploring the Unknown, Selected Documents in the History of the U.S. Civil Space Program, Volume IV, Accessing Space,” NASA History Series, SP-4407, 1999, page 411.

<sup>20</sup> Executive Order 12465, February 24, 1984. Available at <http://ast.faa.gov>.

<sup>21</sup> “First Annual Report to Congress on Administration of the Commercial Space Launch Act,” U.S. Department of Transportation, Office

of Commercial Space Transportation, November 1985, page 7.

<sup>22</sup> The CSLA was codified by Congress in 1994 as 49 US Code, Subtitle IX, Chapter 701.

Available at <http://ast.faa.gov>. Executive Order 12465 remains active and was not replaced by Title 49.

<sup>23</sup> 49 US Code, Subtitle IX, Chapter 701, formerly the Commercial Space Launch Act of 1984, as amended. Available at <http://ast.faa.gov>.

<sup>24</sup> *Ibid.*

<sup>25</sup> *Ibid.*

<sup>26</sup> The Congress would decide to fund a claim if necessary. For more details, see “Liability Risk-Sharing Regime for U.S. Commercial Space Transportation,” April 2002, [http://www.faa.gov/about/office\\_org/headquarter\\_s\\_offices/ast/reports\\_studies/](http://www.faa.gov/about/office_org/headquarter_s_offices/ast/reports_studies/)

<sup>27</sup> Hughes, Timothy and Rosenberg, Esta, “Space Travel Law (and Politics): The Evolution of the Commercial Space Launch Amendments Act of 2004,” *Journal of Space Law*, Volume 31, Number 1, 2005, page 18.

<sup>28</sup> *Ibid.*, page 25.

<sup>29</sup> “FAA Issues License for Historic Sub-Orbital Manned Rocket Launch,” Federal Aviation Administration, news release, April 14, 2004.

<sup>30</sup> Federal Register, Volume 69, No. 153, August 10, 2004, page 48550. This situation is somewhat similar to launch licensing of Orbital Science’s Pegasus XL which air launches from an L-1011 aircraft. During launch operations, the L-1011 is operated under an FAA restricted airworthiness certificate.

<sup>31</sup> “SpaceShipOne Makes History: First Private Manned Mission to Space,” Scaled Composites, press release, June 21, 2004.

<http://www.scaled.com/projects/tierone/062104-2.htm>

<sup>32</sup> “Ansari X PRIZE,” X PRIZE Foundation. <http://space.xprize.org/ansari-x-prize>

<sup>33</sup> Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108-492, 108<sup>th</sup> Congress, 2nd Session.

<sup>34</sup> *Ibid.*

<sup>35</sup> Wong, Ken, “Developing Commercial Human Space Flight Regulations,” Federal Aviation Administration. Presented at International Association for the Advancement of Space Safety conference. May 14, 2007.

<sup>36</sup> Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108-492, 108<sup>th</sup> Congress, 2nd Session.

<sup>37</sup> Hughes, Timothy and Rosenberg, Esta, “Space Travel Law (and Politics): The Evolution of the

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Commercial Space Launch Amendments Act of 2004,” *Journal of Space Law*, Volume 31, Number 1, 2005, page 59.

<sup>38</sup> J. Randall Repcheck, “FAA’s Implementation of the Commercial Space Launch Amendments Act of 2004 – The Experimental Permit,” Federal Aviation Administration, October 2005. Presented at International Association for the Advancement of Space Safety conference.

<sup>39</sup> Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108-492, 108<sup>th</sup> Congress, 2nd Session, 2004.

<sup>40</sup> “2008 U.S. Commercial Space Transportation Developments and Concepts,” Federal Aviation Administration January 2008, page 68. [http://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/reports\\_studies/](http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/)

<sup>41</sup> AST Mission statement, Federal Aviation Administration, 2008. <http://ast.faa.gov>

<sup>42</sup> The report is available at [http://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/reports\\_studies/](http://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/)

<sup>43</sup> Federal Aviation Administration, 2008. [http://www.faa.gov/about/office\\_org/headquarters\\_offices/ast/media/NextGen\\_ConOps\\_Space\\_Annex\\_final\\_v1.0.doc](http://www.faa.gov/about/office_org/headquarters_offices/ast/media/NextGen_ConOps_Space_Annex_final_v1.0.doc)

<sup>44</sup> Under the 2004 CSLAA, there are restrictions on the FAA proposing regulations on certain design and operations of launch vehicles that carry humans until December 2012.