

IAC-17-E7.7.4

FAA INTERNATIONAL WORKSHOPS ON COMMERCIAL SPACE TRANSPORTATION

John Sloan

Federal Aviation Administration
Office of Commercial Space Transportation (FAA/AST)
Washington, DC, United States, john.sloan@faa.gov

Abstract

With the emergence of suborbital space transportation, an increase in demand to launch small satellites, and renewed overall interest in the commercial space sector, regulations from the United States Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) are viewed by other countries as a model to adopt. The FAA has authorized over 310 licensed and permit commercial launches since 1989. As part of international cooperation, the FAA has invited government representatives from several countries to attend specialized regulatory workshops in Washington, DC. Workshops are typically one to two days of detailed briefings by FAA/AST that describe how FAA safety regulations work along with the law and philosophies behind them, and overall give visiting governments the opportunity to ask questions and learn from FAA experience. Each workshop is tailored to individual needs of the visiting government. Many countries are trying to attract suborbital Reusable Launch Vehicles (RLVs) and develop a launch site ("spaceport"). Other countries are interested in how the FAA regulates Expendable Launch Vehicles (ELVs) or want to compare FAA regulations to ongoing privatization efforts. Several countries are developing new legislation for commercial space transportation. A typical workshop covers a variety of FAA regulatory topics such as: RLV licensing and experimental permits, system safety, risk analysis, environmental compliance, inspection, liability and financial responsibility, safety approvals, launch site licensing, human space flight recommended practices, mishaps, and air and space integration. Since 2009, FAA has conducted workshops for seven different countries and one for the European Aviation Safety Agency. The FAA is promoting its regulations for international adoption with a major goal of interoperability. Under U.S. law, any U.S. launch or reentry operated by a U.S. company outside the United States has to be licensed by the FAA. This paper will describe FAA workshops, FAA international outreach activity, and benefits from workshops as countries evaluate future interoperability in commercial space transportation.

1. Introduction

Although commercial launches have been occurring since the 1980s, there has been limited regulatory space transportation cooperation between nations. One reason is many countries do not support the development of new legal regimes for space and consider existing space treaties adequate to ensure oversight responsibility of the private sector. Another is that expendable launch vehicles have relatively short lifespans during launch operations with no point-to-point travel. Many launch sites are next to oceans or in sparsely populated areas with less public safety risk. A third reason is that only a handful of countries have commercially-operated space transportation activities that need regulations.

With a global increase in the capabilities of commercial space operators from suborbital and orbital vehicles to spaceports, small satellites, and new, non-traditional commercial missions to low Earth orbit and beyond, there is renewed interest in establishing or updating national regulatory frameworks. Several countries today are developing new legislation related to commercial space transportation. These include the United Kingdom, Japan, New Zealand, Italy, Curacao, Spain, France, and Australia.

In the United States, the FAA Office of Commercial Space Transportation has been licensing commercial launches, reentries, and launch sites since 1989. With an extensive regime in place that allows for flexibility and growth in commercial space

transportation combined with experience from a wide assortment of vehicles and missions, the FAA and its regulatory approach is viewed as a model for potential adoption by other countries.

The FAA has established regulatory workshops to describe and discuss its commercial space transportation regulations as part of bilateral cooperation with other governments. The workshops cover diverse FAA regulatory topics such as: Reusable Launch Vehicle (RLV) licensing, risk analysis, environmental, inspection, liability, launch site licensing (spaceports), human space flight, mishaps, and air and space integration.

This paper will describe the FAA's international outreach activity, the motivations of other countries related to U.S. cooperation, and details from regulatory workshops.

2. Background on FAA Office of Commercial Space Transportation

The U.S. Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) licenses U.S. commercial launch and reentry activities and the operation of launch and reentry sites by U.S. citizens or activities otherwise in the United States. The FAA is part of the U.S. Department of Transportation (DOT). The law establishing DOT authority, the Commercial Space Launch Act of 1984, as amended, is 51 U.S.C. Chapter 509. The primary mission of FAA/AST is to "protect public health and safety, safety of property, and national security and foreign policy interests of the United States."¹ The office also has a promotion role to "encourage private sector launches, reentries, and associated services and, only to the extent necessary, regulate those launches, reentries, and services to ensure compliance with international obligations of the United States..."²

One of the reasons the Department of Transportation was given authority to regulate commercial space transportation was to consolidate multiple U.S. agency approvals into a single agency for a commercial space launch.

Over time, as U.S. industry has expanded, the U.S. Congress has incrementally added authority beginning with launch and launch sites in 1984, then adding reentry authority in 1998, and limited authority on commercial human spaceflight in 2004. Authority for experimental permits for suborbital vehicle testing was also added in 2004. Initial

commercial regulations were based on those used at federal ranges by the U.S. Air Force.

FAA regulations give industry flexibility without specifying how safety must be achieved (i.e., performance-based regulations). This enables industry to grow and develop, and increases the opportunity for innovation. Unlike in aviation which has a certification regime, the FAA does not certify launch or reentry vehicles or launch sites. Instead, the FAA licenses the launch or reentry operation or the operation of a launch site. The FAA focuses on public safety. Mission success is the responsibility of the commercial operator.

Since 1989, the FAA has licensed over 310 launches (including over 40 suborbital permit launches). The first commercial launch site operator license was granted in 1996 and currently there are 10 licensed sites (or "spaceports") in the U.S. with more in development.

The capabilities and complexity of private industry continues to increase.

Recent commercial capabilities include:

- Expendable vehicles with reusable flyback stages;
- Suborbital reusable launch vehicles;
- Vehicles that use a combination of aircraft with rocket propulsion stages;
- Reentry and landing from orbit;
- Vehicles that can carry people for both suborbital and orbital missions;
- Automated flight termination systems that will allow traditional range tracking equipment to be phased out; and
- Non-traditional missions beyond the original scope of launching satellites to Earth orbit such as: on-orbit satellite servicing, privately operated space stations, asteroid mining, and missions to the Moon and Mars.

One of the challenges for FAA/AST is to be able to write regulations that capture all different types of vehicle capabilities and missions while enabling the growth of industry and ensuring public safety.³

3. FAA Licensing and International

Under U.S. law, the FAA has responsibilities both inside and outside the United States. The FAA must issue a license for any person to launch a launch vehicle, operate a launch or reentry site, or reenter a

vehicle in the United States. It must also license U.S. citizens that launch a launch vehicle or operate a launch or reentry site or reenter and reentry vehicle outside the United States.⁴

Unless U.S. export and non-proliferation policies change regarding launch vehicles, it seems unlikely in the near-term that U.S. companies will be able to sell a launch vehicle outside the United States. For this and perhaps other business reasons, it seems likely that U.S. companies will be operating their vehicles if they choose to launch or reenter outside the United States. As a result, the FAA, has responsibility to license those operations.

4. Origins of FAA/AST International Outreach

In addition to U.S. territory, the FAA Office of Commercial Space Transportation has licensed launches by U.S. providers outside the United States. There have been 36 launches by Sea Launch during 1999-2014 from the Pacific Ocean, a 1997 Orbital Sciences' Pegasus XL launch from Spain (Canary Islands), launches by Orbital Sciences and SpaceX from the Marshall Islands, and two suborbital Hyshot launches by Astrotech from Woomera, Australia in 2001 and 2002.

However, FAA/AST did not have a formal program to address international activity. Nor any international agreements specific to FAA and commercial space transportation. After it became clear that new suborbital companies Virgin Galactic, Rocketplane Global, and XCOR Aerospace were marketing services outside the U.S. before their new Reusable Launch Vehicles (RLVs) were operational, Associate Administrator, Dr. George Nield, established a small international outreach program within AST in 2008. Tasked with starting this effort was AST's John Sloan.

The outreach program developed the following strategy with one overall objective and four supporting goals:

The FAA will promote the international adoption of U.S. commercial space transportation regulations.

The goals of AST's outreach are to:

- 1) Assist U.S. industry activity outside the United States;*
- 2) Provide U.S. international leadership;*
- 3) Establish international relationships; and*
- 4) Prepare for future interoperability between countries.⁵*

Later, the strategy found its way into the U.S. 2010 National Space Policy as part of guidance for agencies to: "promote U.S. commercial space regulations and encourage interoperability with these regulations."⁶ The text was expanded in the 2013 National Space Transportation Policy, which states that the Secretary of Transportation and other appropriate department and agency heads shall: "Advocate internationally for the adoption of United States Government safety regulations, standards, and licensing measures to enhance global interoperability and safety of international commercial space transportation activities."⁷

With interest picking up internationally in commercial space transportation, FAA/AST held a series of initial bilateral meetings during the International Astronautical Congress in 2008 in Glasgow with the United Kingdom, Sweden, and Singapore. After a February 2009 presentation by Dr. George Nield to the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), the FAA set up its first workshops for the first two countries that were interested in learning more about U.S. commercial regulations in-depth: France and Japan.

5. Strategic Motivation in Cooperation with FAA

The most important incentive for cooperation with the FAA appears to be interoperability. Nations want their space transportation industry to be compatible with the U.S. even if there are certain differences in individual laws, policies, or philosophies. This is especially true for new reusable suborbital vehicles which U.S. industry has a technical and financial lead in and may be first to market. Interoperability may also be practical for small expendable launch vehicles. Around 30 small launch vehicles are in development worldwide with most originating in the U.S.⁸ Such an approach also works both ways: for U.S. vehicles to go to other countries and for other country's vehicles to come to the U.S.

Interoperability is probably less of an incentive for larger vehicle operators (such as those in the geosynchronous orbit satellite launch market) that require more expensive infrastructure and may not be ideal for relocation or are considered national assets.

Comparisons to current or planned regulations may also be a motivation. FAA regulations may be

viewed as a “reality check” to verify strategies or identify gaps.

One common theme, based on feedback from workshop attendees, is that nobody wants to try to reinvent the 640-page FAA commercial space transportation regulations book. Selecting what specific elements of FAA regulations and U.S. law to adopt is a primary challenge for countries seeking to adopt U.S. approaches. Both U.S. regulations and law have been continually adjusted to keep pace with industry and other changes.

For example, the original law that established the Office of Commercial Space Transportation in the 1984 Commercial Space Launch Act (CSLA), was about 10 pages in length. As amended (last in 2015), today the CSLA is about 25 pages.

6. Tactical Motivation in Cooperation

From a more tactical perspective, individual countries have different motivations for pursuing cooperation with the FAA that generally comprise combinations of three categories:

- Developing spaceports to attract vehicles;
- Accommodating domestic vehicles; and
- Privatization.

Spain, Curacao, Sweden, Singapore, and Italy first met with the FAA because of new commercial spaceport development plans for particular U.S. or other international companies that they wanted to entice.

The United Kingdom and France began national approaches to develop regulatory frameworks in part to respond to new domestic reusable suborbital and orbital vehicles in development. UK plans also includes domestic spaceports for international vehicles.

New Zealand approached the U.S. about hosting a U.S.-operated launch vehicle. Although Rocket Lab began as New Zealand company, the FAA licensed the launch of the Electron in 2017 because the launch vehicle was operated by U.S. company, Rocket Lab USA. New Zealand is also interested in accommodating other vehicles.

Japan has been steadily privatizing government domestic launch operations of large ELVs by turning over certain activity to Mitsubishi Heavy Industry. Japan is also implementing policies after the passage of different space laws. The 2016 Space Activities

Act sets up a regime to license Japanese private sector launches and other commercial space activity.⁹

France initially met with the FAA in 2009 to compare the FAA (and other U.S. agency regulations) with French plans to implement commercial aspects of the 2008 France Space Operation Act.

There may also be an emerging category: The U.S. is an ideal location for business. Several satellite customers and a strong space investment community reside in the U.S. One of the reasons behind Rocket Lab USA interest in launching in both New Zealand and the U.S. is to work more closely with U.S. satellite customers.¹⁰

In addition, there are also U.S. geographic advantages with experienced launch site operators and low population as well as some government policy advantages: there is an existing regulatory framework and policies are well-established to encourage entrepreneurs at local, state government and federal government levels.

For example, the 2013 National Space Transportation Policy contains several guidelines for federal agencies to encourage and facilitate the commercial sector and while there are trade, import/export, and other considerations in any collaboration, the policy recognizes the potential for mutually beneficial space transportation-related activities: the “United States Government shall consider, on a case-by-case basis, requests to launch foreign space launch vehicles in the United States for commercial purposes, including exhibitions and demonstrations.”¹¹

7. Agreements

The FAA has exchanged letters of cooperation with Spain and Curacao in 2012, signed non-binding agreements about commercial space transportation with Italy and the United Kingdom in 2014, and signed a non-binding agreement on research with the French National Space Agency (CNES) in 2015.¹² These various forms of agreements establish working groups and help strengthen cooperative relationships.

The FAA has yet to sign a binding agreement on commercial space transportation. Reimbursable workshops are a likely future path for the FAA. Agreements are negotiated by the FAA Office of International Affairs.

8. Workshops

The FAA has conducted 15 regulatory workshops for seven different countries and one for the European Aviation Safety Agency.

<i>Year</i>	<i>Regulatory Workshops by FAA/AST</i>
2009	France and Japan
2011	European Aviation Safety Agency
2013	Curacao and United Kingdom
2014	Italy and Curacao
2015	Japan, Italy, and two for United Kingdom
2016	New Zealand, United Arab Emirates, and France
Aug 2017	United Kingdom

The workshops have been held at FAA Headquarters in Washington, DC with the exception of one in Liverpool in the United Kingdom. The duration for most workshops is one and a half or two days while others can last one day or less. Typically, a visiting government brings 4 to 8 representatives from either a national space agency and/or a civil aviation authority or transportation authority.

Most workshops begin with a status presentation by the visiting country followed by a series of in-depth briefings by FAA/AST experts with questions and answers on a wide variety of licensing topics. The FAA Office of International Affairs co-hosts the workshops with AST.

9. Topics in Workshops

Each workshop is tailored to meet the needs and interests of the visiting government while providing a foundation in FAA regulations. For instance, some countries are more interested in orbital launches (sometimes called vertical launch) because of domestic industry needs. Others are focused on spaceports with suborbital vehicle activity.

The following contains the most common workshop topics covered by FAA.

- Reusable Launch Vehicle (RLV) Licensing and Experimental Permits – this extensive session covers pre-application and reviews for both a license and permit. Focus areas include hazards, operating area containment, and RLV operational requirements and restrictions. The FAA uses a three-pronged approach to address

public safety for RLVs: Expected Casualty Analysis, System Safety, and Operating Restrictions.

- Flight Safety Analysis – protecting the public and the risk management process are discussed. Sections include public risk metrics, and debris risk analysis methods and steps.
- RLV System Safety Requirements - this session covers both system safety engineering and management. The FAA has published advisory circulars and guidelines related to system safety.
- Environmental Compliance – The FAA works with applicants to determine what type of review is needed for the following: Code of Federal Regulations (CFR) Part 415 – Launch License, Part 420 – License to Operate a Launch Site, Part 431 – Launch and Reentry of a Reusable Launch Vehicle, Part 433 – License to Operate a Reentry Site, and Part 437 – Experimental Permit. Examples of outcomes of such reviews include an Environmental Assessment or a detailed Environmental Impact Statement.
- Liability and Financial Responsibility – the FAA requires financial responsibility based on a maximum probable loss determination made by FAA/AST. Also discussed are reciprocal waiver of claims requirements and the risk liability regime, popularly known as “indemnification.”
- Safety Approvals - the FAA can approve a component (like a centrifuge or flight termination system) or a training service separately from a launch license application. An approval is voluntary.
- Launch site licensing – this session covers the site licensing process, safety evaluation criteria, launch site location review, responsibilities of a licensee, and a policy review. Topics include control of public access, explosive siting, agreements with air traffic, coast guard, scheduling hazardous operations of customers, and accident investigation plans.
- Inspection – any FAA/AST regulated activity from license and permitted flight operations and site operations to pre-flight operations to safety approval holders is inspected. The FAA’s methodology for inspection is included as well

as technical and regulatory qualifications of inspection personnel.

- Human Space Flight Recommended Practices – in 2014, the FAA released 89 recommended practices for commercial human space flight occupant safety to let industry and government know what practices FAA believes are important for both suborbital and orbital flights. Subcategories mostly include design and operations.
- Mishap Response and Investigation – the FAA has statutory authority to conduct mishap investigations on all FAA-licensed or permitted launch or reentry activities. Each operator is required to have an accident or mishap investigation plan.
- Air and Space Integration - the FAA currently protects aircraft against potential hazards posed by launch and reentry vehicles by using preemptive airspace closures (i.e., segregated airspace). In the future, the FAA plans to move to integration; (i.e., shared airspace). As a result, air traffic management will focus on preventing collisions between vehicles and aircraft rather than collisions between aircraft and falling debris. Obtaining real-time information from vehicles through a Space Data Integrator is discussed.
- AST Structure and Division Briefings- about 100 people work in AST. The head of the office is an Associate Administrator who reports to the FAA Administrator. Within AST there are directors for Integration, Strategic Operations, and Special Projects. There are also five supporting divisions: Space Transportation Development (AST-100), Licensing and Evaluation (AST-200), Regulations and Analysis (AST-300), Safety Inspection (AST-400), and Operations Integration (AST-500).

Additional workshop topics that can be added include: informed consent regime, pre-application consultation, agreements, hybrid launch vehicles, perspectives on historical FAA licensing, and orbital debris mitigation.

10. Conclusion

As nations progress in cooperation with the FAA beyond information exchanges, the FAA is developing more detailed agreements including binding agreements to formalize cooperation and

address expectations. These agreements may include training, future workshops, and other reimbursable activities.

Additional information for U.S. and international audiences about space activity is also being developed by the FAA. The FAA's Mike Monroney Aeronautical Center in Oklahoma created a new course called License2Launch for aerospace professionals that covers introductory material about commercial space transportation and the FAA. Material for the course was provided by AST and the FAA's Civil Aerospace Medical Institute (CAMI).

Feedback from visiting countries about FAA commercial space transportation workshops has been very positive. Some countries have indicated the workshops are valuable for not only legislative and regulatory evaluation but also for comparison in identifying needed personnel skills, organizational structure, and an appreciation of national investment needed to carry out public safety in commercial space transportation.

Countries that have emerging space transportation programs may consider approaching the FAA to discuss future bilateral cooperation and if their individual situation is ready for a regulatory workshop.

The scale and task of amending or creating new laws and implementing them with new regulations for many countries is formidable. The FAA has faced similar challenges with its existing and new regulations despite over 30-years of regulatory experience because of the many diverse capabilities and plans of U.S. industry that push the envelope of what original regulatory intentions were. FAA workshops can provide a solid beginning to regulating commercial space transportation.

References

¹ 51 USC Chapter 509 is available at https://www.faa.gov/about/office_org/headquarters_offices/ast/legislation_policies/

² Ibid. Executive Order 12465 was signed by President Reagan in February 1984, before Congress passed the CSLA. The Executive Order designated

the Department of Transportation as the lead agency within the Federal government for encouraging and facilitating commercial ELV activities by the United States private sector.

³ FAA regulations can be found at:
https://www.faa.gov/about/office_org/headquarters_offices/ast/regulations/

⁴ Under 51 USC § 50904, the FAA must issue a license for: “(1) for a person to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, in the United States. (2) for a citizen of the United States (as defined in section 50902(1)(A) or (B) of this title) to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, outside the United States. (3) for a citizen of the United States (as defined in section 50902(1)(C) of this title) to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, outside the United States and outside the territory of a foreign country unless there is an agreement between the United States Government and the government of the foreign country providing that the government of the foreign country has jurisdiction over the launch or operation or reentry. (4) for a citizen of the United States (as defined in section 50902(1)(C) of this title) to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, in the territory of a foreign country if there is an agreement between the United States Government and the government of the foreign country providing that the United States Government has jurisdiction over the launch or operation or reentry.”

⁵ Statement of Dr. George C. Nield, Associate Administrator for Commercial Space Transportation, of the Federal Aviation Administration, before the House Committee on Science, Space, and Technology, Subcommittee on Space, on Necessary Updates to the Commercial Space Launch Act, February 4, 2014. Available at: <http://docs.house.gov>

⁶ National Space Policy of the United States of America, June 28, 2010, page 6.
https://obamawhitehouse.archives.gov/sites/default/files/national_space_policy_6-28-10.pdf

⁷ National Space Transportation Policy, November 21, 2013, page 5. Available at
https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/national_space_transportation_policy_11212013.pdf

⁸ Niederstrasser, Carlos and Frick, Warren “Small Launch Vehicles- A 2016 State of the Industry Survey,” Orbital ATK. IAC-16-B4.5.10, October 2016. The survey criterion includes: a maximum capability of 500 kilograms to low Earth orbit; the company has to have been active in some form of development during the past three years; and services have to be available for the commercial market.

⁹ Setsuko, Aoki, “New Law Aims to Expand Japan’s Space Business” March 3, 2017, Nippon.com
<http://www.nippon.com/en/currents/d00294/>

¹⁰ Botsford, Ray, “Rocket Lab: The Electron, The Rutherford, and Why Peter Beck Started It in the First Place,” Spaceflight Insider, May 2, 2015,
<http://www.spaceflightinsider.com/missions/commercial/rocket-lab-electron-rutherford-peter-beck-started-first-place/#OxUSjwiI3eXdgw0P.99> “...Beck understands that some U.S. companies will only want to launch from the United States, for one reason or another. Thus the company is also evaluating domestic options, including Cape Canaveral Air Force Station in Florida, as reported by Florida Today.”

¹¹ National Space Transportation Policy, November 21, 2013, Page 8. Available at
https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/national_space_transportation_policy_11212013.pdf

¹² The text of non-binding FAA agreements can be found at:
https://www.faa.gov/about/office_org/headquarters_offices/ast/programs/international_affairs/