

IAC-17-D6.1.4

Expectations for Countries Hosting FAA-Licensed Commercial Launches

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Abstract

Several nations are developing regulatory frameworks for commercial space transportation vehicles and spaceports. For vehicles operated by companies from the United States in non-U.S. locations, the U.S. Federal Aviation Administration (FAA) has authority to license the launches and reentries. The FAA Office of Commercial Space Transportation has licensed over 260 launches. There are some limitations on the FAA's level of insight into non-U.S. activity; however, the FAA does have a degree of flexibility in working with other countries. As a result, the scope of regulations for non-U.S. launches and reentries differs slightly from domestic launches and reentries. While individual license cases vary, and each country with existing or new regulatory frameworks will have different national laws and safety rules, there are some general subject areas that countries may wish to consider when hosting U.S. vehicles. One such area is ground safety. Under FAA regulations, launch processing and post-launch operations for launch points outside the U.S. may be subject to the requirements of the governing jurisdiction (i.e., the host country). However, the FAA does require certain pre-flight activities to protect the public. Another area is the launch site. Unless the launch site operator is a U.S. person (or the site is operated by the U.S. launch operator as a sole-user site), the FAA would not license the launch site operation. Under an FAA license, the launch site operator would be responsible for control of public access, explosive siting, lightning protection, and other items. In addition, there may be other areas where the host country can satisfy FAA regulations, such as adoption of existing environmental reviews. As part of FAA regulations, air traffic agreements are required between the launch operator and the local civil aviation authority. This paper will describe differences in how the FAA regulates a launch outside the United States compared to inside the United States. The paper will also offer suggestions on other areas to consider. The purpose of the paper is to provide governments and companies a greater understanding of regulatory responsibilities a host country may want to consider in order to accommodate a U.S. launch or reentry operator.

1. Introduction

As commercial space transportation capabilities expand, several nations are developing new legal and regulatory frameworks. Some nations are interested in developing new launch sites (spaceports) and/or launch vehicles, while others are focused on attracting commercially-operated vehicles that have been developed in other countries. One existing legal and regulatory framework that is being considered as a model is the one used by the United States Department of Transportation (DOT). The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST), part of DOT, has licensed over 260 commercial launches since 1989,

including both orbital and suborbital missions. In addition, FAA/AST currently licenses the operation of 10 non-federal launch sites. It has also licensed the reentry of vehicles from orbit. While most of the missions originated in the United States, some have taken place in other countries. Under U.S. law, any U.S. entity that conducts a launch or reentry either inside or outside the United States must be licensed by the FAA.¹

However, there are differences in the actions the FAA takes for a U.S. domestic launch or reentry, as compared with its role for operations conducted outside the United States.

The purpose of this paper is to address these differences and highlight some of the activities that the FAA oversees, either based on regulatory requirements or on policy consistency. Our hope is that governments hosting the launch or reentry of a U.S. commercial vehicle will gain a greater understanding of potential safety responsibilities to be considered.

The FAA has some limitations on the level of insight it has for non-U.S. activities; however, it also has a degree of flexibility in working with other countries. As in any joint-international activity, the specifics of each case may vary depending on individual laws, regulations, and other policies.

It is important to note that the FAA can only enforce its own regulations; it cannot enforce (or waive) local or host country regulations.

2. DOT/FAA Licensing Background

Since the passage of the 1984 U.S. Commercial Space Launch Act, which covered traditional Expendable Launch Vehicles (ELVs) and launch sites, the U.S. Congress has made several amendments to keep pace with changes in private industry. These include adding authority for reentries, Reusable Launch Vehicles (RLVs), and human space flight. Moreover, regulations derived from U.S. law have been continually refined.

The FAA has responsibility for protecting public health and safety, the safety of property, and the national security and foreign policy interests of the United States. In addition, the FAA is directed to encourage, facilitate, and promote commercial space launches and reentries by the private sector.

The following major themes and philosophies are contained in FAA commercial space transportation regulations:

- Public safety is the primary FAA responsibility;
 - The FAA licenses launch or reentry operations, but does not certify launch or reentry vehicles;
 - Regulations are limited to the “extent necessary” and are intended to evolve as industry matures, without stifling technology development;
 - Under current law, the FAA cannot issue new regulations to protect people onboard vehicles until a “learning period” expires in 2023; and
- Most of the safety responsibility is on the launch or reentry vehicle operator, as opposed to the launch site operator.

U.S. law requires a launch license for: 1) anyone to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, in the United States, and 2) a citizen of the United States (including a U.S. corporation or a majority U.S.-owned foreign corporation) to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, outside the United States.²

The types of vehicle, mission, and launch site (federal site or commercial FAA-licensed site) determine which particular FAA regulations apply and which do not. For example, RLVs have different requirements than do ELVs. Suborbital vehicles can be either ELVs or RLVs. An orbital launch vehicle can have both ELV and RLV components, and a separate reentry license can be issued for space vehicles that return from orbit for intact landing.

License applicants work closely with the FAA during the pre-application process, while the license evaluation is being conducted, and throughout the launch process itself.

License applicants are required to enter into a pre-application process. During this process, the FAA works with the intended applicant to ensure that their application is in a state that is complete enough to properly evaluate.

There are a series of reviews included in the license evaluation process that cover environmental requirements, policy, payloads, financial responsibility (insurance and risk), and public safety (hazard analysis). As part of the safety review, plans for coordination with the local air and marine traffic authorities are required. Through an interagency consultation process, other U.S. agencies are asked to comment on environmental, payload, and policy reviews.

After the evaluation and issuance of the license, the FAA sends inspectors to oversee each launch, to ensure that the actions actually performed by the operator are consistent with what was submitted in the application, and that any special terms and conditions placed on the license are followed.

For suborbital RLVs, the FAA offers the option to apply for an experimental permit, either instead of,

or in addition to, a launch license. A permit is intended to facilitate RLV development, including flight testing or crew training. A permit cannot be used for operations involving compensation or hire, nor is a permittee eligible for the FAA's risk liability regime (popularly known as "indemnification").³

Suborbital rockets and suborbital trajectories have specific definitions under FAA regulations:

- **Suborbital Rocket:** A vehicle, rocket-propelled in whole or in part, intended for flight on a suborbital trajectory, and the thrust of which is greater than its lift for the majority of the rocket-powered portion of its ascent.
- **Suborbital Trajectory:** The intentional flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth.

Launch site operators have to meet requirements for control of public access, explosive siting, lightning protection, and air/marine traffic coordination.

If a launch operator is the sole user of their own launch site (as is the case for Blue Origin in west Texas and for SpaceX at their site near Brownsville, Texas), there is no separate requirement for a launch site license. Instead, requirements related to site operations are included as part of an FAA launch license.

All of FAA commercial space transportation regulations are available at: <https://www.faa.gov/go/ast>

The differences between FAA domestic and international licensing are related to two primary characteristics: 1) the level of insight the FAA would have (or needs to have) into activity in a non-U.S. country, and 2) the potential to recognize equivalent requirements from the host country.

The following sections describe in more detail the differences in U.S. domestic and international licensing (or permitting).

3. License Applicability

One of the key considerations in defining the applicability of a launch license, from the FAA perspective, is the definition of when a launch begins

and ends in accordance with the U.S. Code of Federal Regulations (CFR)⁴. This also determines the window of "indemnification".

The FAA defines the beginning of launch as the time when the launch vehicle arrives at the launch site. For any launch in the United States, the applicability of the license coincides with duration of the launch. This means that, for U.S. domestic ELV launches, there are considerable pre-flight activities on a non-federal launch site that are covered under the "ground safety" regulations (417 Subpart E) and that are captured within the license requirements.

In contrast, for a launch outside the United States that is licensed by the FAA, the applicability of the launch license begins "at ignition" or when the wheels start rolling on a runway for an RLV. This is due to the fact that ground safety regulations, as detailed in 14 CFR 417 Subpart E, are only applicable to U.S. domestic launches⁵ and to the limitations on the level of insight related to pre-flight activities.

Although FAA has some flexibility in defining when the launch license applicability begins outside of the United States, current practice has been to define ignition as the beginning of licensed activity. That is the approach that has been used for launches by Sea Launch from the Pacific Ocean, and for launches by Rocket Lab USA from New Zealand.⁶

One of the reasons for different approaches is that outside the U.S., the FAA looks to the host government to exercise authority over activities on its soil. Another factor is that in the international launches the FAA has licensed to date (such as Hyshot from Woomera, Australia, and Sea Launch from the Pacific Ocean), the population risk has been relatively low. For more details on the reasoning behind when launch begins, see the 1999 FAA Final Rule.⁷

The end of the applicability for the launch license coincides with the end of launch, and is the same for U.S. and non-U.S. launches. For an ELV, it is defined as the licensee's last exercise of control over its launch vehicle, including payload deployment and vehicle safing activities. The end of launch for an RLV is defined as occurring "after deployment of the payload" or "upon completion of the first sustained, steady-state orbit" for orbital RLVs, and safing of the vehicle for suborbital or reentering RLVs.

Even though the applicability of the license is time-limited, that does not limit the period during which activities can be evaluated or inspected. Some developments during flight that can affect public safety have roots in pre-flight activity that may precede the beginning of the licensed operation.

4. Ground Safety and Pre-flight Processing

Due to the aforementioned restrictions on the applicability of the regulations for non-U.S. launches, the FAA does not oversee many details of ground safety in the time period leading up to ignition. However, there are several important functions that occur pre-flight, potentially before the license is issued, that the FAA inspects after license issuance to protect public safety.

Even though ground safety regulations are non-applicable at a non-U.S. launch site, the following pre-flight processing sections are applicable even at a non-U.S. launch site:

4.1. Launch description (14 CFR § 415.109)

This section requires a launch site description including identification of any facilities at the launch site that will be used for pre-flight launch processing.

4.2. Launch reporting requirements and launch specific updates (14 CFR § 417.17)

There are several launch reporting requirements that launch operators operating outside of the U.S. are still responsible for, as specified in § 417.17, even though they extend well before the period of the license. For example, command control system acceptance test and age surveillance test reports have a ground operation element.

4.3. Launch personnel qualifications and certification (14 CFR § 417.105)

Having a qualified launch crew doing ground operations is required. At a federal range, the FAA limits the scope of the personnel qualification and certification requirements to the license applicant's safety officials, since there is confidence in U.S. range practices and previously evaluated equivalency. However, at a non-federal range and, by extension, a non-U.S. launch site, a more detailed evaluation of the launch personnel training process is conducted.

4.4. Launch plans (14 CFR § 417.111)

This section contains the requirement for identification of procedures for surveillance and clearance of the flight hazard area established for each launch as required by § 417.223. Evaluation and verification of these activities ensures the validity of

the assumptions made in the flight safety analysis that determines public risk during flight.

4.5. Launch safety rules (14 CFR § 417.113)

Surveillance, monitoring of meteorological conditions, flight safety system safing, and launch crew work shift and rest rules have pre-flight ground operation elements that are not exempt from FAA oversight.

4.6. Tests (14 CFR § 417.115)

While ground system tests that are part of this section would be exempt, traditional flight safety system testing has ground based command control system and support system testing that needs to be performed under FAA oversight.

4.7. Reviews (14 CFR § 417.117)

A number of pre-flight reviews are required in this section, including the review of personnel qualification (§ 417.105 Launch personnel qualifications and certification) and pre-launch rehearsals (§ 417.119 Rehearsals).

4.8. Rehearsals (14 CFR § 417.119)

This section lists a number of pre-flight rehearsals that need to be performed, including a countdown rehearsal, emergency response rehearsal, and a communications rehearsal, with at least one simulated abnormal preflight condition that would impact public safety.

4.9. Safety critical preflight operations (14 CFR § 417.121)

All safety critical preflight operations must be identified in advance and are required to have FAA oversight. This section offers excellent guidance on relevant sections and activities, including surveillance and orbital collision avoidance coordination.

4.10. Support systems and flight safety system analysis (14 CFR §§ 417.307 and 417.309)

The ground segment of the flight safety system and command control system requirements are still required to meet the requirements in these sections, including some pre-flight checks.

5. Environmental

It is likely that a host country for a U.S. vehicle has environmental rules and regulations and associated approval processes. The FAA would consider the host country's environmental review process and make a determination if additional environmental analysis on the part of the FAA is required prior to issuance of a launch license. In

addition to having to follow the host country's environmental rules and regulations, the operator must follow the requirement specified in §415.201, if applicable. Under 14 CFR § 415.201, "An applicant shall provide the FAA with information for the FAA to analyze the environmental impacts associated with a proposed launch." The FAA complies with the requirements of the National Environment Policy Act, 42 U.S.C. 4321 et seq. (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA, 40 CFR parts 1500-1508, and FAA Order 1050.1F.

As a general matter, NEPA does not apply to actions taken outside the territory of the United States, absent the potential for domestic environmental impacts.

U.S. Executive Order 12114 requires U.S. federal agencies to consider whether actions "encompassed by the Order" would have a significant effect outside the United States, its territories, and possessions.⁸

As a recent example, the FAA licensed the first launch attempt by Rocket Lab USA from New Zealand in May 2017. It was found that New Zealand environmental laws fully covered U.S. environmental laws and that EO 12114 did not apply.

6. Launch Site

While the FAA does not evaluate ground safety regulations for launches outside the U.S., as mentioned earlier, a description of the launch site is required. This information is used in conjunction with the flight safety analysis to evaluate various safety zones. This allows the evaluation and inspection of the adequacy of surveillance of those zones to ensure the validity of the assumptions related to the affected uninvolved public.

To date, the FAA has not licensed a launch or reentry site outside the United States, because the site operator has not been a U.S. person. Under an FAA license, the launch site operator would be responsible for control of public access, explosive siting, lightning protection, and other items.⁹

7. Post Launch Operations

Launch operators launching outside of the U.S. are still obligated to follow several post-launch requirements. These include post-launch reporting 90 days after the end of launch, providing information to support the registration of space objects, and mishap procedures, should an incident occur during launch.

8. Other areas outside of FAA Regulations

There are several additional safety areas related to commercial space launches and launch site operations that host countries may want to consider, that are that are not part of FAA licensing authority.

8.1. Worker Safety

As mentioned earlier, DOT/FAA regulations focus on public safety. In the United States, general worker safety is addressed by the Occupational Safety and Health Administration (OSHA). A host country may wish to consider how to assess individual worker safety. Under Part 417, the FAA asks launch operators to identify critical safety positions and to describe work hour schedules that may or may not be subject to host country requirements. During a launch campaign, the number of work hours leading up to the scheduled launch date, or after scrubs, may be more than planned. The FAA has requirements in the U.S. on the number of hours in a work shift, including time off between shifts.

8.2. Transport of hazardous materials

The movement of rocket fuel and large equipment to and from populated areas may require safety monitoring. In the U.S., DOT is responsible for the transport of hazardous materials.

8.3. Training, expertise, and local regulations

Although the FAA looks into the training and certification process of the safety officials, contractors and employees of the launch provider and the launch site or mission control center may need specific safety training and knowledge of local and national rules and regulations. The expertise of the launch operator and support contractors may need to be verified. How these needs are enforced may be part of the host country's responsibility.

8.4. Public access enforcement

For launches from a U.S. federal range or launch site, enforcing limits on public access and clearing boats and airplanes from downrange hazard areas is a federal responsibility. For non-federal FAA-licensed sites, responsibility is determined by the launch or reentry operator and/or the launch or reentry site operator's agreements with the appropriate air traffic and maritime authority. For a commercially-operated launch site in a non-U.S. country, determining who has jurisdiction in advance of launch day may be an important consideration.

8.5. Other licenses

One of the purposes of the U.S. interagency consultation process is to notify other agencies about

the launch of payloads that may require other licenses. Examples include communications licenses from the Federal Communications Commission (FCC), or commercial remote-sensing licenses from the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA).

9. U.S. Export Policies and Technology Safeguards Agreements

U.S. export policies can affect a variety of issues in space launch and satellite programs. The Department of State administers the International Traffic and Arms Regulations (ITAR), and the Department of Commerce oversees the Export Administration Regulations (EAR). In general, space transportation is handled by the Department of State, while most satellite-related activity is under the Department of Commerce.

A first step for many U.S. companies under ITAR jurisdiction is to establish a Technical Assistance Agreement (TAA) with another country. A TAA is an agreement for the performance of a defense service or the disclosure of technical data, as opposed to an agreement granting a license or right to manufacture defense articles.¹⁰

The United States aligns its export control regulations with major multilateral regimes, such as the Missile Technology Control Regime (MTCR), which controls items needed for missile development, production, and operation, and the Wassenaar Arrangement (WA), charged with promoting transparency and greater responsibility.¹¹

Most U.S. export controls are based on an item or service's inherent technical capabilities, not on its intended end use. Since export regulations are subject to ongoing revisions, applicants should consult with the Departments of State and Commerce for the most recent information.^{12 13}

The U.S. State Department may also require a Technology Safeguards Agreement (TSA) for countries that want to host U.S. launch vehicles. The TSA is a bilateral agreement that protects unauthorized access to, or transfer of technologies associated with, U.S. launch vehicles and spacecraft. In addition, a TSA may contain terms and conditions about non-U.S. spacecraft, as well as conditions related to the MTCR.

The terms and conditions of a TSA may impact the oversight of a U.S. launch or reentry operator. For example, New Zealand signed a TSA (and a side agreement) with the U.S. in 2016.¹⁴ The following

text is from the U.S. - New Zealand TSA: "This Agreement specifies the technology safeguards procedures to be followed for Launch Activities, including procedures for controlling access to U.S. Launch Vehicles, U.S. Spacecraft, Related Equipment, Technical Data and areas containing these items at facilities in New Zealand. This Agreement shall apply to all phases of Launch Activities, including activities at all facilities of the U.S. Licensees, activities at all facilities under the jurisdiction and/or control of New Zealand, and activities of N.Z. Representatives and U.S. Participants. This Agreement shall also apply to all phases of transportation of U.S. Launch Vehicles, U.S. Spacecraft, Related Equipment and/or Technical Data."¹⁵

Note that the TSA and other export agreements are separate from an FAA launch or reentry license.

10. Conclusion

There are some important differences in FAA commercial space transportation licensing for launches and reentries that take place outside the United States that merit consideration by the host government and U.S. launch operator.

In highlighting these differences and the rationale behind them, the FAA is demonstrating its commitment to facilitate future launch coordination and interoperability.

Early consultation between governments and industry operators on respective responsibilities will help to promote public safety. By clarifying current FAA practices for launches and reentries outside the United States, it is hoped that complementary processes and regulations can be developed that are comprehensive, efficient, and consistent.

References

¹ Similarly, if a U.S. citizen were operating a launch site outside the United States, an FAA license is required. To date, the FAA has not issued such a license.

² Restrictions on launches, operations, and reentries, 51 USC § 50904.

³ The FAA has a three-tier risk liability regime, popularly known as indemnification. Licensees and Permittees must obtain liability insurance or demonstrate financial responsibility to compensate for the maximum probable loss (MPL) from claims

by: A third party for death, bodily injury, or property damage or loss; and the U.S. Government for damage or loss to government property.

See the 2006 FAA study on Liability Risk-Sharing Regime at:

https://www.faa.gov/about/office_org/headquarters_offices/ast/reports_studies/library/

⁴ Definitions, 14 CFR § 401.5 (2015).

⁵ Ground Safety - Scope, 14 CFR § 417.401.

⁶ For example, the Rocket Lab USA FAA License Order No. LLS 17-095A, May 15, 2017, is available at:

http://www.faa.gov/data_research/commercial_space_data/licenses/. The FAA May 2017 license states that: ““Launch” shall mean the flight of a Rocket Lab Electron launch vehicle commencing with ignition of the first stage from Rocket Lab Launch Complex (RLLC) and transporting a payload to low Earth orbit.”

⁷ 14 CFR Parts 401, 411, 413, 415 and 417
https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/14cfr-401-417.pdf
https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/14cfr-401-417.pdf

⁸ Executive Order 12114 -- Environmental effects abroad of major Federal actions
<https://www.archives.gov/federal-register/codification/executive-order/12114.html>

⁹ License to Operate a Launch Site, 14 CFR Part 420.

¹⁰ See ITAR §120.22 for more on Technical Assistance Agreements.

¹¹ For more on MTCR and the Wassenaar Agreement, including a list of member states, see <http://mtrc.info> and <http://www.wassenaar.org>

¹² See more on ITAR at the U.S. Department of State website:

<https://www.pmdtdc.state.gov>

¹³ See more on the EAR at the U.S. Department of Commerce website: <https://www.bis.doc.gov>

¹⁴ See the text of the New Zealand TSA at: <http://www.mbie.govt.nz/info-services/sectors-industries/space/new-zealand-space-agency/regulatory-regime#tsa>

¹⁵ Ministry of Business, Innovation and Employment (MBIE), 2016: <http://www.mbie.govt.nz/info-services/sectors-industries/space/new-zealand-space-agency/document-image-library/folder-pdf-library/technology-safeguards-agreement-US.pdf>