Commercial Space

The FAA’s Office of Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activities including launch and reentry of vehicles and operation of non-federal launch and reentry sites authorized by Executive Order 12465 and Title 51 U.S. Code, Subtitle V, Chapter 509 (formerly the Commercial Space Launch Act). Notably, AST’s purview does not extend to military or civilian government [e.g., National Aeronautics and Space Administration (NASA)] launches. Title 51 and the Executive Order also direct the U.S. Department of Transportation to encourage, facilitate, and promote U.S. commercial launches. The FAA’s mission is to license and regulate commercial launch and reentry operations and non-federal launch sites to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States. With its dual mission of regulating and also promoting the emerging commercial space transportation industry, FAA faces unique challenges.

The FAA licenses launches or reentries carried out by U.S. persons inside or outside the United States. The FAA does not license launches or reentries the U.S. Government carries out for the Government (such as those operated for and by NASA or the Department of Defense). FAA does not license or grant permits for amateur-class rockets which are unmanned rockets that have less than 200,000 pound-seconds of total impulse and cannot reach an altitude greater than 150 kilometers above the Earth’s surface.

To accomplish its mission, the FAA performs the following major functions:

- Maintains an effective regulatory framework for commercial space transportation activities by developing regulations and guidance,
- Provides guidance to prospective commercial operators on how to comply with regulatory requirements for obtaining an authorization and operating safely,
- Evaluates applications for licenses, experimental permits, and safety approvals for launch and reentry operations and related commercial space activities,
- Evaluates applications for licenses for launch and reentry site operations,
- Monitors and enforces regulatory compliance through safety inspections of launches, reentries, sites, and other regulated commercial space activities,
- Provides U.S. Government oversight of investigations associated with the mishap of an FAA authorized launch or reentry,
- Facilitates the integration of commercial space launch and reentry operations into the National Airspace System (NAS) by coordinating airspace use and regulatory oversight with air traffic management and Federal launch ranges,
- Coordinates research into the safety, environmental, and operational implications of new technologies and the
evolving commercial space transportation industry,

- Conducts outreach to the commercial space industry by hosting working groups and conferences,

- Collaborates with Government partners, such as NASA, Defense Advanced Research Projects Agency (DARPA), and the U.S. Air Force to assure consistent approaches to regulation, policy, and standards, and

- Conducts outreach to international counterparts to promote a balanced and consistent regulatory framework across the world.

In addition to FAA headquarters offices in Washington, D.C., AST maintains field offices near active launch ranges to facilitate communication with space launch operators and to implement FAA’s regulatory responsibilities more efficiently. AST personnel are currently assigned to four field offices in close proximity to: Kennedy Space Center in Florida; Johnson Space Center in Texas; and, Vandenberg Air Force Base and the Mojave Air and Space Port in California. Due to industry expansion, FAA is considering additional field offices to accommodate the anticipated increase in launch and reentry operations in other parts of the United States. FAA also directly supports NASA’s commercial space initiatives by providing on-site staff at both the Johnson Space Center and Kennedy Space Center to coordinate the FAA’s regulatory and enforcement activities with NASA’s development and operational requirements for commercial space.

Regulatory Safety Oversight Activities of FAA

The business cycle from the time a firm first contacts FAA until the last launch of a licensed operation can be several years. There are many important activities performed by FAA during this cycle. The most notable activities are described here.

Pre-Application Consultation for Licenses, Experimental Permits and Safety Approvals

Prospective applicants seeking commercial space transportation licenses, experimental permits, or safety approvals are required by regulation to consult with FAA before submitting their applications. During this period, FAA assists them in identifying potential obstacles to authorization issuance and determining potential approaches to regulatory compliance. The growth in both the number of commercial space operators and the number of operations will likely increase FAA’s pre-application consultation workload over the next five years. Furthermore, many new operators are seeking to incorporate new technologies, vehicle types, or operational models that create challenges for FAA in determining the applicable regulations or approach to regulatory compliance.

Licenses, Permits and Safety Approvals

An increasing number of applicants for licenses, permits, safety approvals, and renewals has a direct impact on the number of launches and reentries at some uncertain point in the future. Though many licenses authorize multiple launches (for mature launch systems), the need remains for FAA to also issue individual launch licenses for systems that are still maturing, especially those systems for human space flight missions. Furthermore, with the dynamic commercial space industry, FAA often evaluates launch and reentry systems and operations that are
Inherent in the review process is the requirement to conduct policy reviews and payload reviews. When conducting a policy review, FAA determines whether the proposed launch, reentry, or site operation presents any issues that would jeopardize public health and safety or the safety of property, adversely affect U.S. national security or foreign policy interests, or be inconsistent with international obligations of the United States. If not otherwise exempt from review, FAA reviews a payload proposed for launch or reentry to determine whether the payload would jeopardize public health and safety, the safety of property, U.S. national security or foreign policy interests, or the international obligations of the United States. The policy or payload determination becomes part of the licensing record on which FAA’s licensing determination is based.

FAA also reviews and issues launch and reentry site operator licenses and license renewals. FAA also reviews and evaluates launch site license applications for launch sites located in foreign countries but operating with U.S.-licensed launch or reentry systems. FAA coordinates range planning among Federal, state, and local governments and with the commercial range operators or users. As part of the evaluation of applications for launch licenses, reentry licenses, and site operator licenses, FAA also conducts environmental reviews consistent with its responsibilities under the National Environmental Policy Act.

FAA anticipates issuing a growing number of safety approvals for space launch systems equipment, processes, technicians, training and other supporting activities. FAA reviews, evaluates, and issues safety approvals to support the continued introduction of new safety systems, safety operations applications, and safety approval renewal applications.

**Safety Analyses**

FAA conducts flight safety, system safety, maximum probable loss, and explosive safety analyses to support the evaluation and issuance of licenses and permits. FAA also evaluates and analyzes the performance and capabilities of space flight crews to determine how human factors affect overall public safety risk. As commercial firms become more involved with human space flight activity, FAA will evaluate, analyze, and determine the health risks to the space flight participants (crew and “passengers”) due to natural and flight-induced launch and reentry environments, as well as any hazardous ground operations directly associated with the flight. FAA will also need to evaluate the safety of ground operations at “spaceports” and exclusive-use sites.

**Inspections and Enforcement**

FAA currently conducts as many as 400 pre-flight/reentry, flight/reentry, and post-flight/reentry safety inspections per year, often conducting several inspections simultaneously, at any of the approximately 20 U.S. and international commercial space launch sites. The establishment of non-federal launch sites requires additional inspections in areas such as ground safety that have traditionally been overseen by the U.S. Air Force at Federal ranges. At spaceports and launch sites with high launch rates (e.g., Cape Canaveral Air Force Station, Vandenberg Air Force Base, the Mid-Atlantic Regional Spaceport, and Spaceport America), at least 85 percent of the inspections must be conducted by locally-based field inspectors in order to respond to a dynamic operational
tempo, minimize cost, and increase efficiency.

Mishap Investigations
Multiple mishap events in 2015 demonstrated that FAA must have the capacity to investigate at least two space launch or reentry mishaps or accidents simultaneously anywhere in the world, and to lead as many as six investigations during a single year. FAA must have the capabilities and resources to safely perform the investigations lasting as long as 16 weeks at remote sites with no infrastructure or facilities. FAA must have the capability and resources to efficiently review all applicant mishap plans and accident investigation procedures as part of the license and permit evaluation process.

NAS Integration
AST works in partnership with all FAA lines-of-business, notably the Air Traffic Organization (ATO) and Office of Airports (ARP) to support the safe and efficient integration of commercial launch and reentry operations into the NAS and its system of airports and air traffic managed by the ATO. AST expects an increased level of interaction with the ATO, ARP, and the FAA Office of NextGen (ANG). This includes an increased presence at the Air Traffic Control System Command Center and other locations to assist in the strategic and tactical planning of launch and reentry operations, as well as to provide support during these operations. Further, AST will continue the development of technologies to facilitate safe and efficient integration of commercial launch and reentry operations into the NAS, in partnership with ANG and ATO, including technologies to improve the integration of launch and reentry data into FAA air traffic control systems and technologies to improve the timely and accurate development and distribution of notices of aircraft hazard areas.

FAA’s Operations Forecast
To improve its workforce planning process, in 2014, FAA adopted an approach to estimate its future staffing needs based on the ratio of regulatory safety oversight staff to a forecast of launch and reentry operations within the purview of the FAA mission. Although it was a modest improvement, this change set the groundwork for FAA to implement a more objective and transparent process for projecting staffing requirements and also necessitated development of credible operations forecasts. Since 2014, FAA has made several important improvements to its operations forecast:

- In 2015, FAA began using planned launch and reentry data collected from operators and prospective applicants as the starting point for its launch and reentry forecasts. This change enabled FAA to simplify and improve its forecasting methodology by tying launch and reentry forecasts directly to anticipated operations by commercial space transportation firms known to FAA, rather than to aggregate industry demand.

- Because commercial spaceflight is a highly dynamic and rapidly evolving industry, it was quickly determined that operator-provided data alone were not a reliable indicator of future activity. There is a natural, inherent bias by industry to be optimistic about their business prospects. Consequently, FAA adopts a cautionary view of what industry representatives say will happen versus what may reasonably be expected to happen. A primary pillar of FAA’s forecasting methodology is to err on the side of caution and take a conservative view of industry growth. Therefore, in
2016, FAA further refined its forecasting methodology by using observations about historical launch activity to establish better forecasting parameters for both new applicants and existing operators.

Based on proprietary information available to FAA, an increase in launch and reentry activities expected in the coming years. There are several factors that magnify the challenges associated with predicting the number of launches and reentries to expect in a given year. They include:

- the list of firms intending to launch or actually launch is dynamic,
- the continued development of new technologies, and
- mishaps.

For example, the number of firms actively communicating with FAA increased from 14 in August of 2014 to 46 three years later, an increase of more than 300%. New technologies [e.g., reusable launch vehicles (RLVs)] allow a faster operational tempo, and at the same time, early use of these technologies can increase the probability of a mishap. A mishap can derail launch plans for one or more firms. Investigations and subsequent “return to flight” for firms impacted by a mishap can take months to years. Taking these factors into account, the following table and graph provide historical activity and FAA’s forecast through calendar year 2020.
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<th>Fiscal Year</th>
<th>Actual/Forecast</th>
<th>AST Licensed and Permitted Operations</th>
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<td>2013</td>
<td>Actual</td>
<td>20</td>
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<td>2014</td>
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<td>2020</td>
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Notes:
1. Forecast entries represent the Low to High estimate.
2. Six mishaps in 2015 caused the number of launch and reentry operations to fall significantly from the previous year rather than increase as expected.
It is important to note that the operations included in the forecast will occur at a variety of locations throughout the National Airspace System (NAS). That is, not all launch and reentry activity occurs at one location, for example, at Cape Canaveral, Florida. In the past year, FAA licensed launches and reentries throughout the NAS and beyond, including multiple reentries in the Pacific Ocean and one licensed launch from New Zealand. Furthermore, the forecast above only deals with launches and reentries licensed by FAA. It does not include launch activity for the rest of the world, and it is not tied exclusively to satellite demand.

Additional Factors Affecting Forecast Accuracy

Commercial space transportation is a rapidly evolving industry. The industry’s growth through technological innovation and the development of new markets increases the challenges associated with forecasting commercial space transportation operations.

New Commercial Launch Technologies and Operations are Emerging on an Accelerated Basis

The commercial space transportation industry is exploring a variety of new technologies and new approaches to space launch and reentry. In late 2015, both Blue Origin and Space Exploration Technologies Corp. (SpaceX) successfully demonstrated the reusability of their rockets, a development that could significantly reduce the cost of operations and lead to an increase in the number of launch and reentry operations per year. Several other U.S. commercial entities are also pursuing the development of reusable launch vehicles (RLVs). At the same time, state and local governments are joining with commercial firms to promote additional launch and reentry sites, and some firms are seeking to establish launch sites for their exclusive use. This added launch capacity sets the stage for simultaneous operations and an increase in the number operations per year.

New Markets for Commercial Space Transportation are Emerging

The continuing development of commercial space transportation technology has spurred new markets for commercial space transportation services. As private industry continues to develop and test new vehicles capable of taking space flight participants on suborbital and orbital flights, companies and organizations are proposing to offer human space flight training and several organizations have already begun to provide this service. States and municipalities have sought to open new spaceports to attract commercial space transportation and associated high-tech firms and create business hubs for research and development. Since 2008, the NASA has managed the Commercial Resupply Services (CRS) program, which acquires transportation services from commercial providers to deliver cargo to and from the International Space Station (ISS). NASA is also working with commercial companies under its Commercial Crew Transportation Capabilities contract to develop vehicles that will provide transportation for astronauts and international partners to and from the ISS. These vehicles are expected to commence test flights and subsequent operational missions within the next five years. The commercial vehicles used by NASA for cargo and crew transportation will have other commercial applications that increase the capabilities of the commercial space transportation industry as a whole.
Looking further afield, there are several companies in the regulatory pipeline seeking authority to land commercial vehicles on the Moon, establish private-sector space stations, service satellites on-orbit, and establish launch sites using non-traditional technologies like railguns and tube launchers. Extensive FAA resources will be needed to determine how these unprecedented commercial space ventures will impact public safety and U.S. national interests.