

Testimony of Mike Moses
President, Virgin Galactic
House Transportation and Infrastructure Committee
Aviation Subcommittee
June 16, 2021

Chairman Larsen, Ranking Member Graves, members of the Aviation Subcommittee and staff, and my fellow panelists, thank you for the opportunity to provide testimony for this hearing, *“Starships and Stripes Forever – An Examination of the FAA’s Role in the Future of Spaceflight.”*

I am the President of Space Missions and Safety for Virgin Galactic. I joined the company in 2011 following a career at NASA. While at NASA I worked as a flight controller on the Shuttle program and then later as a Flight Director at NASA Johnson Space Center where I led teams of flight controllers in the planning, training, and execution of space shuttle missions. Afterwards, I served at the Kennedy Space Center as the Launch Integration Manager, leading the space shuttle program activities for vehicle processing from landing through launch. My tenure at NASA has given me the perspective, insight, and experience for operations planning and safe execution of human spaceflight which is my top responsibility at Virgin Galactic. I am also proud to be currently serving as a member of COMSTAC, the Commercial Space Transportation Advisory Committee, which acts to support the FAA Office of Commercial Space Transportation and the FAA Administrator.

In my testimony today, I’d like to provide an overview of Virgin Galactic, our accomplishments, and our future plans. In addition, I will discuss current industry regulations, and the future needs of those regulations to address continued growth and safety of the industry, as well as its role in the global competitiveness our industry faces. Specifically, I’ll outline how the learning period affects our sector, the needs of commercial space integration into the airspace system, FAA licensing requirements, our space support vehicles, and space infrastructure.

About Virgin Galactic

Virgin Galactic was founded as the world’s first commercial spaceline in 2004 with the ambitious goal of flying private astronauts to space. Founded by Sir Richard Branson, we are a vertically integrated U.S. aerospace company headquartered in California and New Mexico with a mission of opening access to space to change the world for good.

Our fleet is based on the historic SpaceShipOne vehicle—which was the first private space vehicle to safely carry human beings into space, which it did in 2004, claiming the Ansari X PRIZE. Virgin Galactic’s vehicles were designed with the intention of opening frequent access to space and providing a transformational spaceflight experience to our astronauts. Our system is suborbital – it allows our astronauts to journey to space, beyond the Earth’s atmosphere, and experience several minutes of floating freely about the cabin, out of your seat, experiencing zero-gravity and

witnessing the incredible views of Earth from space. Our suborbital spaceflight system consists of two vehicles: Mothership (pictured in Figure 1) is a four-engine, dual-fuselage jet aircraft capable of high-altitude heavy lift missions. And our SpaceShip class of vehicles, which are suborbital spaceplanes carried by the mothership and designed to transport people and scientific research safely and routinely to suborbital space and back.



Figure 1: Mothership Carrier Aircraft, VMS EVE

Our current spaceship in flight test is SpaceShipTwo, VSS *Unity* (shown in Figure 2). Our SpaceShips are flown by two experienced pilots and can carry up to six spaceflight participants or about 1000 pounds of science and technology research experiments to space altitudes where they will have exposure to 3-4 minutes of a high-quality microgravity environment. To date, we have flown to space three times from two states, all of which carried NASA Flight Opportunities Program research experiments on board. Virgin Galactic's spaceship is the only human-rated, crew-piloted suborbital system in the world. We provide our customers with a transformational experience to gaze down at our Earth and take in all the inspiration that our planet can offer. In addition, Virgin Galactic also provides spaceflights that can be used for professional astronaut training, as well as research, education, and other industrial applications to develop and test new applications and technologies.



Figure 2: SpaceShipTwo, VSS Unity

On March 30, 2021, Virgin Galactic rolled out our second spaceship and the flagship of the next generation of the SpaceShip fleet – SpaceShip III, VSS *Imagine* (pictured in Figure 3). VSS *Imagine* was manufactured in our Mojave, California, facility and will begin its flight test program this summer from Spaceport America – our operational headquarters in New Mexico – with powered

flights following next year. As VSS *Imagine* begins its test program, manufacturing will progress on VSS *Inspire*, the second SpaceShip III vehicle, bringing the total number of spaceships within the Virgin Galactic fleet to three. The introduction of the SpaceShip III class of vehicles is an important milestone in Virgin Galactic's multi-year effort that targets flying 400 flights per year, as these new vehicles were designed specifically to increase performance and reduce the time needed between flights.



Figure 3: SpaceShip III, VSS *Imagine*

Industry Regulations

The commercial space industry has seen significant growth in the past decade. The U.S.-based space sector is made up of companies with private and public financial backing working on a myriad of missions including human spaceflight, satellite constellations, and beyond Low-Earth Orbit (LEO) operations, expanding the potential of exploration once again with lunar missions, Mars landers and rovers, and recently announced Venus missions. Many of these goals are through public-private partnerships as well as through industry-driven ambitions.

The Commercial Space Launch Act of 1984, as amended and re-codified at 51 U.S.C. §§ 50901-23, authorizes the Department of Transportation to oversee, license, and regulate commercial launch and reentry activities. In 1995, the Federal Aviation Administration's (FAA) Office of Commercial Space Transportation (AST) was created after the Secretary of Transportation delegated the authority to exercise oversight responsibilities of these activities to the FAA Administrator. FAA AST's regulatory authority over commercial launch and reentry activities is prioritized to protecting public safety, national security, and U.S. foreign policy interests. This regulatory approach is necessary to encourage the emerging commercial space industry while prioritizing the safety of the public. These principles continue to be important for the development of the commercial space industry today.

FAA Licensing

Space Policy Directive 2 (SPD-2), released in 2018, called for the Executive Branch agencies to review existing regulations and ensure rules are not duplicative while continuing to promote economic growth, advance national security and foreign policy goals, and encourage U.S. commercial space leadership. In response to SPD-2, the Department of Transportation, through FAA AST, conducted a rulemaking effort on launch and reentry licensing for commercial space transportation vehicles. The new Part 450 regulations aimed to consolidate multiple regulatory

parts to create a single licensing regime for all types of commercial spaceflight launch and reentry operations with the goal of replacing prescriptive requirements with performance-based criteria. Currently Virgin Galactic is operating under a Part 431 Operators License, originally issued on July 26, 2016.

While Virgin Galactic supports these streamlined regulations – moving toward performance-based metrics as opposed to prescriptive – it should be noted that further evaluation of the regulations will occur as new and existing launch operators update their licenses and there is still work to be done. Specifically of concern to suborbital operators like Virgin Galactic, the new Part 450 regulations combined previous regulations and added an additional layer of intricacy typically seen for larger, more complex systems used for orbital spaceflight. However, the FAA has always been an important partner for industry and has shown willingness to work with the commercial sector on issues that arise during the licensing process as long as it does not compromise their primary public safety objective. As Virgin Galactic and all launch operators work through the new Part 450 regulations, we encourage the FAA to continue its channel of open dialogue and discussion for addressing inadvertent issues that may arise in a new regulatory regime quickly and in a manner that does not delay or impact commercial business.

[The Learning Period](#)

In the act of passing and re-authorizing the Commercial Space Launch Act, Congress acknowledged that the current emergence of the commercial human spaceflight industry is in a dynamic, iterative, and development cycle, and is not yet ready for the full-scale regulation that characterizes today's commercial air travel. Understanding that it is impossible for regulators to create effective and efficient regulations for diverse, innovative vehicles without sufficient data, Congress created a regulatory learning period during which FAA may regulate for the safety of the public, or in response to an incident. The rationale was that "FAA regulatory burdens on the relatively new and rapidly evolving commercial space launch industry could slow innovation, particularly when it remains to be clear which areas the FAA should regulate."

This learning period was initially enacted in 2004 to ensure that industry had time to develop and create a sufficient database of knowledge on which to base future commercial space regulations. Due to the technical and economic challenges of spaceflight and the industry's emphasis on safety, commercial space companies did not progress as quickly as was once envisioned. Congress correctly acknowledged that the learning period did not fully accomplish its intended purpose and extended it– most recently with the Commercial Space Launch Competitiveness Act (CSLCA), which extended it to Oct. 1, 2023. Before the learning period sunsets, Congress should work with industry to determine if sufficient experience, data, and metrics are available to define those areas most critical to regulate to meet Congress' public policy objectives.

In Title 51 U.S.C. § 50905(c)(6), Congress directed the FAA to submit a report specifying key industry metrics that might indicate a proper level of maturity for the commercial space industry to be fit for regulation. Section 50905(c)(7) of that same legislation also directed the FAA to

submit another report every two years on “the commercial space activities most appropriate for regulatory action, if any, and a proposed transition plan for such regulations.”

On October 20, 2017, the FAA submitted its first report to Congress specifying the key metrics that may indicate the commercial space sector’s readiness for regulations. The FAA divided the indicators into three sets. The first set of indicators looks to the industry’s readiness to enter a safety framework by focusing on the purpose for which people are flying, the size and complexity of the industry, and its safety. The second set are indicators of the industry’s progress in developing a safety framework and focuses on voluntary safety reporting, voluntary consensus standards, and compliance. The final set of indicators relate to the FAA’s readiness to enter into a safety framework and focuses on the FAA’s authority and expertise.

There are several core premises that underlie the FAA’s indicators:

1. The human spaceflight industry must continually improve its safety performance.
2. The safety framework should grow and mature as the industry does.
3. As the purpose of space travel evolves from adventure, to occupation, and on to transportation, the public’s expectation of safety increases.

Both the identified indicators and their underlying premises are in line with Congress’ intention, noted in 51 U.S.C. § 509019(a)(15):

“[t]he regulatory standards governing human spaceflight must evolve as the industry matures so that regulations neither stifle technology development nor expose crew, government astronauts, or spaceflight participants to avoidable risks as the public comes to expect greater safety for crew, government astronauts, and spaceflight participants from the industry.”

On February 26, 2019, the FAA submitted its reports on the commercial human spaceflight activities most appropriate for regulatory action. The FAA concluded in that report that “[b]ased on the readiness indicators provided in FAA’s October 2017 report to Congress, there are no commercial human spaceflight activities that are ready for a new safety framework that may include regulatory action.” In fact, the FAA accurately recognized that “[a]t this point in the commercial human spaceflight industry’s evolution, transition to a new safety framework might stifle technology development.”

Since that report, there have been multiple exciting developments in the commercial spaceflight industry, but industry has not quite achieved the levels described in the indicators. On May 22, 2021, Virgin Galactic’s VSS Unity flew to space for the third time in total, and the first from our operational headquarters at Spaceport America in New Mexico. This made the Land of Enchantment the third state in the history of the United States to send humans into space. With this achievement, we are on the precipice of commercial service and it is more important than ever that we focus on that mission. Until we have a data set of additional successful flights, new

regulations could be unintentionally burdensome and potentially stifle development at this critical juncture for companies such as ours.

Moreover, the size and complexity of the industry is still maturing. For suborbital flights, the industry only has one horizontal launch suborbital company, Virgin Galactic, and one vertical launch suborbital company, Blue Origin. So far, Virgin Galactic has only had three human suborbital flights to space, while Blue Origin plans to have its first suborbital flight with humans in the coming months. While new entrants with financial backing are joining the commercial industry every year, the current very limited frequency of human spaceflight is an indicator that the sector is still developing.

Most importantly, we also want to emphasize that the spaceflight companies themselves hold a vested interest in safety and safe performance. Virgin Galactic's North Star has been and always will be safety – a mindset shared throughout the commercial space sector. Our latest flight to space from New Mexico marked the 400th FAA-licensed launch maintaining the FAA's perfect public safety record.

As a member of COMSTAC's Safety Working Group, I am proud to share that we are working closely with the FAA regarding the development of commercial spaceflight voluntary industry consensus standards. In September 2020, COMSTAC's Safety Working Group made multiple recommendations to COMSTAC regarding this topic, highlighting the importance of this topic to everyone involved in our industry. We are currently focused on soliciting industry feedback to update supporting documents from FAA that industry will need upon conclusion of the learning period. Some of this information is almost two decades old and needs significant attention.

ASTM International is a leading standards development organization with over 120 years of experience. They currently have upward of 12,500 published standards across a wide array of industries. ASTM's F47 Committee on Commercial Spaceflight was initiated a few years ago and Virgin Galactic has been an active participant since the committee's inception. F47 is comprised of a variety of experts from government, industry, and academia. To date, they have published four standards, one pending a vote, seven that will be up for ballot by the end of the year, and five still under review. Out of the seventeen standards that are currently published or under consideration, eleven are related to human spaceflight standards.

Simultaneously, the Commercial Spaceflight Federation, which has over 70 member companies, has been working diligently to pursue ever-higher levels of safety and share best practices and expertise throughout the industry.

While all this progress has been beneficial, more time is needed to increase the overall standards framework. Given the diversity of vehicles and services within the industry, achieving helpful and applicable standards requires significant resources and collaboration. For human spaceflight alone, we have systems that launch vertically, horizontally, and even balloons that slowly ascend high into the atmosphere. With committees, advisory groups, and organizations actively working with the FAA to establish commercial spaceflight safety standards, the industry is constantly

innovating safety systems, designs, and operations. Continuing informed discussions about the learning period is imperative to allow the industry and regulators to develop a safety framework that will best protect the health and safety of crew, government astronauts, and spaceflight participants while also ensuring our industry is the global leader in commercial space. It is without question that the learning period has enabled the commercial space industry to innovate for safety more quickly than they would if early regulations not based in industry data were in place. The learning period has given FAA the opportunity to collaborate with industry so that both FAA and industry are better able to achieve the highest levels of safety. Therefore, Congress should continue to engage with industry and the FAA to create a versatile regulatory framework that will optimize safety standards and maintain our current high levels of innovation.

Commercial Space Integration into Airspace

Our commercial base of operation in New Mexico is located within White Sands Missile Range's restricted airspace, thus our impact on airspace and air traffic during our launches is minimal.

While all commercial space launch vehicles are different, commercial space operations are not currently a large user of the National Airspace System (NAS), but these operations serve very important functions in our nation's commerce, civil, and national security priorities. Furthermore, because both their speed and their direction of flight are so different from aircraft, rockets and spaceplanes typically occupy the NAS for only a few minutes or even seconds per flight, rather than lingering or passing through the airspace for hours at a time. However, as the industry's launch cadence increases, it drives the need for efficient and streamlined processes for continued seamless integration into the airspace. This will require investment in efficient, effective processes and technical tools such as the Space Data Integrator and others. In addition, the Next Generation Air Transportation System (NextGen) is key to coordinating use of the NAS between all users. Programs developed to fix these problems are available, however they must be prioritized, funded, and integrated into the current system. Upgrades such as these will allow the FAA to manage the interactions between space and aviation users of the NAS in the most effective, efficient manner possible while minimizing mutual impacts.

Space Support Vehicles

As mentioned earlier in this testimony, Virgin Galactic operates a hybrid vehicle system, consisting of both an aircraft and spacecraft. During operations when Virgin Galactic has no intent to launch, such as pilot training flights on our Mothership or glide flights without a rocket motor with our spaceship, we operate under a FAA-issued Experimental Airworthiness Certificate. Our Mothership is a unique aircraft that has an operating ceiling higher than typical commercial airliners. While Mothership's primary purpose is to support the launch of our SpaceShip, its unique capabilities have garnered interest from both the civil and national security research community for alternative uses. While Mothership provides a unique platform, developed as part of a spaceflight system that is not accessible in typical commercial services, we are currently unable to support these communities' R&D without filing a petition for an exemption to the rule that restricts carriage of property (experiments) from compensation or hire. In addition to these

research-related aviation activities, the Mothership also can support multiple other roles related to spaceflight activities, such as pilot and customer training and technology demonstration. In 2018, the Commercial Space Support Vehicle Act was passed as part of FAA Reauthorization bill which allows for Space Support Vehicle flights for hire, if the flight relates to launch and reentry purposes, such as training or technology development. We recommend Congress continue to encourage the use of “Space Support Vehicles” to allow for R&D only these unique vehicles are capable of.

International Competitiveness

The United States is the world leader in developing a thriving and growing commercial space sector. As other countries’ space programs grow, so do their commercial space industries, and while we value our partnerships with our space allies, it is also necessary for the United States to remain a global leader. As we learned with airspace requirements, when the United States sets standards, other countries follow. The United States should set a precedent when creating a regulatory environment that prioritizes safety, while encouraging, facilitating, and promoting the growth of the nation’s space industrial base. The FAA should continue to engage internationally to create streamlined regulatory environments that do not create burdensome and duplicative requirements to operate overseas. This will encourage growth and use of the U.S. space industry globally – with countries utilizing the U.S. space sector instead of creating competing industries.

Moreover, both the House and Senate introduced legislation to compete internationally with countries who put billions of dollars into their STEM education and fields in order to create a new generation of technical thinkers and leaders. Virgin Galactic values our engineers, mathematicians, scientists, and technical employees. We simply could not do business without them and need a pipeline of future hires for our business to be successful and to compete on a global scale.

Space and Spaceport Infrastructure

Improvements to our nation’s infrastructure are currently under negotiation by this committee and others in Congress as well as the administration. We have observed proposed inclusion and improvement projects across both public and private sectors. Many sectors include traditional infrastructure: highways, bridges, dams; as well as new designations of infrastructure: broadband access, childcare, and schools. However, it is very important that space be included in discussions regarding infrastructure as improvement resources and programs are formulated. Protecting and improving space infrastructure is critical to life in the 21st century and should be prioritized. Having secure space infrastructure is a key enabler of military operations, banking operations, GPS, and a host of applications and services most Americans take for granted. Likewise, launch sites and spaceports are key to maintaining and improving our space ecosystem. The commercial space industry values its partnerships with entities in increasingly diverse fields and markets that seek to access space and who otherwise could not without the versatile vehicles, satellites, launch facilities, and research capabilities offered by this industry.

To further support space infrastructure, we should consider enhancing support for commercial spaceflight launch facilities to ensure reliable and redundant access points to space. Airports benefit greatly from Airport Improvement Program (AIP) grants, which are awarded for the planning and development of public-use – and in some cases, to private owners and entities – airports to improve runways and facilities as they service the aviation industry and the American economy. Spaceports have similar needs when it comes to maintaining and improving infrastructure. Different from airports, however, modern U.S. spaceports are “flexible” in that they support various vertical and horizontal launch systems that require unique infrastructure elements. However, spaceports are not eligible for AIP grants and there are currently no other forms of federal transportation grant programs available to them. Efforts to address this problem are ongoing and include innovative new funding mechanisms such as that proposed by Ranking Member Garrett Graves last Congress (H.R. 7313).

Virgin Galactic supports the of inclusion of the space sector as infrastructure and we look forward to continued discussions around providing adequate support, as well as federal support for the launch facility infrastructure needed to keep the United States competitive as the global space economy continues to grow.

Conclusion

This is an exciting time for not only Virgin Galactic, but for the entire industry as it continues to mark milestones in human spaceflight. The Committee’s tireless work and progress on aviation and aerospace regulation is imperative and much appreciated by the public, those of us in this room, our companies, and stakeholders. Thank you for holding this important hearing and I look forward to working with the Committee and to answer any questions.