

**PROMOTING SAFETY, INNOVATION,
AND COMPETITIVENESS IN U.S.
COMMERCIAL HUMAN SPACE ACTIVITIES**

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE AND SCIENCE

OF THE

**COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE**

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

OCTOBER 18, 2023

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

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PROMOTING SAFETY, INNOVATION, AND COMPETITIVENESS IN U.S. COMMERCIAL HUMAN SPACE ACTIVITIES

WEDNESDAY, OCTOBER 18, 2023

U.S. SENATE,
SUBCOMMITTEE ON SPACE AND SCIENCE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 2 p.m., in room SR-253, Russell Senate Office Building, Hon. Kyrsten Sinema, Chairman of the Subcommittee, presiding.

Present: Senators Sinema [presiding], Cantwell, Peters, Luján, Hickenlooper, Schmitt, and Cruz.

OPENING STATEMENT OF HON. KYRSTEN SINEMA, U.S. SENATOR FROM ARIZONA

Senator SINEMA. This subcommittee is now in order. Welcome, everyone, to our hearing of the U.S. Senate Space and Science Subcommittee. Thank you to each of our witnesses for their participation today.

Thanks to Subcommittee Ranking Member Schmitt for working with me on these issues, and to Chair Cantwell and Ranking Member Cruz for their collaboration. Today's hearing comes at a critical time for the commercial space industry. Bold, flexible, bipartisan policies have fostered U.S. commercial space from its infancy to the world's gold standard of today.

It is not a coincidence that the United States is about the only country where private companies are engaged in human spaceflight and the world leader in space innovation and development.

Continued American leadership depends on a robust private sector. Space innovation is no longer the exclusive domain of the Government. As private companies bring private citizens to space, we can see the immense potential of commercial human spaceflight.

Commercial space activities can now go from theoretical to very real at lightning speed. Commercial space companies right now employ thousands of Americans, have nationwide supply chains, and leverage the already immense economic impact of Government space operations.

America's private space efforts are all the more critical, with increasing global investments in space, including from foreign competitors and adversaries like Russia and China. My home State of Arizona continues its space leadership with significant commercial space investment.

Virgin Galactic's massive manufacturing complex in Mesa is set to be operational next year, and I am looking forward to seeing the new Delta fleet roll out in time for 2025 flight testing. That means meaningful careers for Arizonans and a tremendous boost to the local economy.

Earlier this year, Blue Origin opened a 43,000 square foot office in Phoenix, taking advantage of the region's excellent engineering talent to further its avionics systems engineering and supply chain management, and I am sure the breathtaking mountain views don't hurt.

Along with hundreds of employees, Blue Origin is also investing hundreds of millions of dollars in local Arizona firms to support all of its programs, including commercial human spaceflight. These investments follow recent large scale expansions of existing facilities by Northrop Grumman and Boeing.

My alma mater, Arizona State University, launched New Space, an unprecedented collaboration effort integrating academic and commercial space enterprises. Now, SpaceX may not yet have Arizona facilities, but it did successfully launch the ASU led Psyche spacecraft on one of its Falcon heavy rockets just last Friday, and all of this investment benefits from public space projects.

In Arizona alone, NASA accounted for over \$700 million and over 3,800 jobs in 2021. Progress in commercial space finds us at the dawn of a new space age. Much of the industry, particularly human spaceflight, is just now entering phases of rapid development.

Commercial human spaceflight did not become a regular occurrence until the last few years, and I am glad to have all three private companies currently flying humans into space here today so we can hear how the Government can help boost and safeguard your operations.

Congress finds itself with a unique opportunity to help grow an industry with vast potential and important responsibility to do so carefully. We must maintain U.S. leadership by ensuring our space industry retains the freedom to innovate without compromising safety.

We must draw on prior experience and take the same enterprising, pioneering approach to commercial space that has served us so well in earlier generations. We need to streamline authorization processes, enable a workable safety framework for in-space operations, and clearly define proper responsibilities for Government agencies in commercial space.

I believe this requires a flexible regulatory environment able to attack the issues of today head on without compromising adaptability for the issues of tomorrow. We must address the learning period, mission authorization, and other pressing matters in a way that looks ahead to the future with unknown capabilities.

To do this, we need to account for the diversity of operations in commercial space and the human spaceflight industry. Our three industry representatives today show how there is no singular approach to human spaceflight. Laws and regulations must account for diversity without sacrificing efficiency.

To maintain our leadership and competitiveness in the growing commercial space economy, we will also need a strong workforce to support it. I am passionate about making sure that Americans and

Arizonans have rewarding careers to choose from when graduating either from a certificate program, vocational school, or with advanced degrees.

Encouraging public, private partnerships and leveraging existing expertise of entities like NASA will be critical. Regulators must also be given proper resources to keep pace with growing industry. We cannot expect any regulatory framework to function without the necessary expertise to oversee such a complex industry.

So, thank you. And I will now turn to Ranking Member Shitt—Schmitt for this opening statement.

**STATEMENT OF HON. ERIC SCHMITT,
U.S. SENATOR FROM MISSOURI**

[Laughter.]

Senator SCHMITT. It is not the first time that has happened.

[Laughter.]

Senator SINEMA. It is actually——

Senator SCHMITT. It is the first time here.

Senator SINEMA. It is actually not the first time today.

[Laughter.]

Senator SCHMITT. You are right. I have been called worse.

[Laughter.]

Senator SINEMA. You are recognized.

Senator SCHMITT. Thank you, Madam Chair. And thank you to the witnesses for joining us here today. My home State of Missouri has helped chart the path of human exploration.

As the gateway to the West, Lewis and Clark set out from Saint Charles, Missouri, at the confluence of the Missouri and Mississippi Rivers to further our Nation's Westward expansion to the Pacific Ocean.

Additionally, Marshfield, Missouri's native son Edwin Hubble, proved that there were galaxies beyond the Milky Way, offering new realms of discovery. America's drive for exploring the unknown has always been a unifying force for our country, and our Nation has and always should be at the forefront of exploration, period.

Dating back to the advent of the space race and human exploration in the Mercury missions, the need for the U.S. to be the pre-eminent leader in space has been critical to our national and economic security.

Then Russia was our key adversary. Today it is China. The U.S. is privileged to have some of the foremost aerospace companies in the world, with three of them represented in front of us here today.

As Ranking Member of the Space and Science subcommittee, I want to do everything in my power to leverage the abilities and innovation of the U.S. company—of those U.S. companies in order to maintain American space dominance.

When considering new frameworks for regulation in space, it is imperative that the appropriate agencies develop thoughtful, light touch standards for the development and deployment of technologies of suborbital, orbital, cislunar, and lunar commercial operations.

Innovation thrives under light touch regulations, not the heavy hand of Government. The FAA's moratorium on regulating com-

mercial spaceflight operations, otherwise known as the learning period, is set to expire on January 1, 2024.

The learning period has afforded us the robust commercial spaceflight industry we have here today. It is important that that learning period be extended to provide both industry and the FAA enough time and data to establish an appropriate off ramp to a more permanent framework for the commercial space industry.

We must also streamline and reform existing regulations within the FAA and the Department of Commerce to refocus our Federal agencies' core functions on top of timely licensing and safety to ensure that the American companies lead the world.

I have led efforts here in the Senate with my colleagues, Senator Hickenlooper, to streamline the FCC's role in spectrum licensing for commercial space launch and reentry to provide a more certain and timely licensing process that keeps pace with the increased launch and reentry demands of the commercial space industry.

That bill has passed committee and I hope we can get it passed on the floor actually this week. I intend to take that same approach in an approach that emphasizes timely review and approval of licenses and certifications when it comes to the processes at the FAA and the Department of Commerce.

Additionally, it is important that the larger commercial space industry has regulatory certainty and clarity to plan for the future, to head off the larger threat of China and our adversaries in space.

If Federal agencies continue to stray from their core functions or add to the current bureaucratic mess, we could very well see valuable American companies leave our shores. I for one, and I know my colleagues join me in not wanting to see that happen.

I believe that those agencies play an important and critical role in commercial space development. However, when agencies start stepping in overreach, it becomes unclear what the agency guidance actually is and who is in charge of what.

We only further put ourselves at a disadvantage. Congress should not stand idly by and watch agency turf wars. We must be clear eyed about the goal, stopping China through American space dominance.

To me, nothing could be more important. Madam Chair, as we look to the new frontier of space exploration and future generations, America must be the first back to the moon. The first nation to set foot on Mars. The first nation to capture and harness the resources of the galactic asteroids.

These goals are vital to the next stage of human curiosity. Our future generations depend on us to get this right. I look forward to hearing from the witnesses here today to ensure this committee develops a thoughtful and balanced approach to any future commercial space exploration bill or commercial space bill that promotes, not hinders, American industry. I yield back.

Senator SINEMA. Thank you. I am now going to introduce our witnesses for today's hearing. Our first witness is Caryn Schenewerk. Ms. Schenewerk is the President of CS Consulting and an adjunct Space Law Professor at Georgetown University Law Center.

She was formerly the Vice President for Government Affairs at Relativity Space and spent 10 years at SpaceX. You are recognized for your opening statement.

**STATEMENT OF CARYN SCHENEWERK, PRESIDENT,
CS CONSULTING, LLC**

Ms. SCHENEWERK. Chair Sinema, Ranking Member Schmitt, and distinguished members of the Committee, thank you for inviting me to share my perspective on the U.S. commercial space industry.

I am honored to appear before the Committee in my personal capacity, and I am not representing any company or client's views. My testimony is focused on a few key points regarding U.S. space law and policy governing private space activities.

I hope to convey that space is highly regulated and that maintaining America's competitive edge in space is increasingly dependent on improving and streamlining existing regulatory processes. It also depends on our ability to develop an efficient and effective approach to authorizing exciting new or so-called novel space activities.

My first point, the U.S. space industry is highly regulated and encompasses a diverse range of activities with different levels of maturity and customers. As such, it operates in accordance with a multitude of local, State, and Federal laws, and depending on where companies operate, they may also be subject to foreign laws. U.S. space companies are licensed based on their primary activities, launch, reentry, remote sensing, and telecommunications, by the FAA, NOAA, and FCC, respectively.

That said, each of those activities may also require licenses from one or both of the non-primary agencies. Importantly, we do not have a one stop shop approach to licensing space activities. Second, launch and reentry companies are subject to U.S. law no matter where they operate, and an efficient approach to regulating them is crucial to their success.

Such jurisdiction was established in the 1994 Commercial Space Launch Act and conforms to the United States' international treaty obligations. The primary focus of the CSLA based licensing regulations and review for launch and reentry is public safety, which requires the FAA to review the design, operation, and testing of a vehicle's flight safety system, as well as aspects like vehicle hazards, including debris, toxic release, and overpressure.

As outlined in my written statement, obtaining a launch or reentry license is an extensive, multi-year effort. Recent changes to the FAA's regulations have not resulted in streamlined licensing reviews. Instead, Part 450 has proven more cumbersome and costly. To date, only four licenses have been issued under Part 450, and at least two of those exceeded the FAA's 180 day statutory timeline.

With respect to human spaceflight, the learning period or moratorium does not limit all regulatory oversight. For example, the FAA regulates to protect crew members because they are part of a vehicle's flight safety system, which falls within FAA's public safety authority.

There are regulations regarding spaceflight participants as well, including their training and their acceptance of risk. Given the lim-

ited number of private human spaceflights, 3 orbital and 10 sub-orbital, the ongoing opportunities for thoughtful engagement between the FAA and industry, as well as the FAA's challenges with implementing its existing regulations, the original premise underpinning the learning period still appear solid.

Next, I would like to focus on novel activities, an emerging aspect of the space market. These include in-space servicing, assembly and manufacturing, in-space destinations such as private LEO space stations, and Moon or Mars based capabilities.

These are exciting endeavors that do not clearly fall within FAA, FCC, or NOAA's licensing regimes. Significant support exists for the Commerce Department's Office of Commercial Space having mission authority over novel space activities. I recommend that this committee support efforts to clarify agency authorities in a manner that is appropriate to the in-space activities and ensure that any regulatory regime is well-defined.

Continued uncertainty will diminish U.S. space leadership and is costly to companies developing these novel and necessary capabilities. Last, effective regulatory regimes require resourced, trained, and organized regulators who engage meaningfully with cutting edge innovations.

U.S. space law and policy—U.S. space policy and legal oversight is extensive, and we must continuously work to make sure its implementation is keeping pace with industry's rapid technological and scientific advances. Sometimes the safest approach may not look like the status quo.

As the Committee considers commercial space legislation, it has the opportunity to continue U.S. leadership in diminishing regulatory uncertainty, while facilitating continued space safety, innovation, and competitiveness.

Thank you for the time you are investing in developing balanced and thoughtful legislation. I look forward to your questions.

[The prepared statement of Ms. Schenewerk follows:]

PREPARED STATEMENT OF CARYN SCHENEWERK¹, PRESIDENT, CS CONSULTING, LLC

Chair Sinema, Ranking Member Schmitt, and distinguished members of the Committee: thank you for inviting me to share my perspective on the U.S. commercial space industry, particularly the importance of effective, streamlined regulations that promote safety, innovation and competitiveness.

The U.S. commercial space industry is rapidly innovating and on a growth trajectory relative to the world-wide space market.² The commercial space market includes international and domestic space services, which are dominated by in-space activities, namely satellite-based services and their supporting ground systems.³ The U.S. segment of that market is growing as is the U.S. segment of the launch services market.⁴

U.S. space companies are represented in all aspects of the international space economy as well as in the U.S. civil and national security space markets. U.S. commercial space companies are providing Astronaut carriage and cargo delivery to the International Space Station under contract with NASA. Notably the U.S. is the only

¹This testimony is provided in my personal capacity; it does not represent any company or clients' views. It does rely, in part, on Steve Mirmina & Caryn Schenewerk, *International Space Law and Space Laws of the United States* (Cheltenham, UK; Northampton, MA: Edward Elgar, 2022).

²*State of the Satellite Industry Report*, SIA (2022) <https://sia.org/news-resources/state-of-the-satellite-industry-report/>.

³*Ibid.*

⁴The commercial launch market includes launch services provided to international commercial companies as well as foreign governments in accordance with U.S. export control laws.

country where private human spaceflight activities are currently occurring. The U.S. is also leading in the development of novel, space technologies, including commercial human destinations in Earth's orbit; in-space satellite servicing, assembly and manufacturing; lunar landers and rovers; and nuclear thermal propulsion.

Forward-looking policies that were implemented decades ago and thoughtfully extended and expanded, particularly the Commercial Space Launch Act, have significantly contributed to the U.S. commercial space industry's success. When the CSLA was originally codified in 1994, it was in anticipation of commercial launch, it did not yet include reentry or human spaceflight. Congress focused on the near-term issue and devised a tailored solution that has since been updated as the industry has evolved. As this Committee contemplates the oversight of emerging, commercial endeavors in space, a similarly tailored, flexible approach that can be updated as innovation and space exploration evolve will continue to serve the country's interest in maintaining its competitiveness, developing capabilities that advance our national security, and fostering safety.

The focus of my testimony will be U.S. Government oversight of commercial space activities, particularly the authorities granted under the Commercial Space Launch Act (CSLA), as amended. The intent is to provide the Committee with historical and legal context as well as a review of key space regulations and their implementation in order to inform its efforts to develop legislation that results in balanced and thoughtful regulations.

The U.S. space industry is highly regulated.

The companies that comprise the U.S. commercial space industry are regulated by a multitude of Federal agencies as well as state and local governments. They may also be regulated by foreign governments, depending on where they are operating or providing services. The jurisdictions and resulting U.S. Federal regulations are defined for certain companies based on their primary activities—launch, reentry, remote sensing, and telecommunications are regulated by the FAA, NOAA and FCC, respectively. That said, each of those activities may also require licenses from one or both of the non-primary regulating agency. In other words, an activity that is licensed by the FAA may also require a FCC and/or NOAA license.

If the space activity is “novel” such as in-space servicing, assembly, manufacturing or in-space destinations, such as LEO habitats or based on the moon or Mars, then it does not clearly fall within the licensing regimes of the three above-listed agencies. These novel activities have been the focus of National Space Council discussions in this and the last Administration. Significant support exists for the Department of Commerce's Office of Commercial Space having “mission authority.” I recommend that this Committee support efforts to clarify agency authorities in a manner that is appropriate to the in-space activities and ensure that any regulatory regime is clearly defined. Continued uncertainty will diminish U.S. space leadership and is costly to companies developing these novel and necessary capabilities.

In addition to regulations governing companies' space activities, their manufacturing activities, facilities and test sites are regulated by federal, state and local regulations governing environmental, labor and transportation activities, among others. For example, when companies ship space systems⁵ by road, air or sea, they are subject to state and Federal transportation and safety regulations overseen by state departments of transportation, the U.S. DOT Pipeline and Hazardous Materials Safety Administration (PHMSA), Federal Aviation Administration, and U.S. Coast Guard. When companies utilize legacy U.S. government capabilities such as launch sites or test stands on U.S. Space Force or NASA facilities, for example, they are subject to the controlling agency's rules and requirements.

U.S. space companies are also subject to Federal laws governing international trade in goods and services as well as foreign investment. U.S. export control laws governing space activities include the International Traffic in Arms Regulations (ITAR), which controls the export and import of defense-related articles and services on the United States Munitions List (USML) and is administered by the Directorate of Defense Trade Controls (DDTC) within the U.S. State Department. Activities and aerospace hardware not subject to the ITAR may be subject to Export Administration Regulations (EAR) under the Commerce Control List (CCL) administered by the Department of Commerce's Bureau of Industry and Security (BIS). Companies must also comply with the Office of Foreign Assets Control's various sanctions programs as well as the Committee on Foreign Investment in the United States' regulations.

⁵ Launch vehicle, reentry vehicles, satellites, and other space hardware.

International Space Law History & Context

In 1958, one year after Sputnik 1, the United Nations (UN) created an Outer Space Affairs Division. Also in 1958, the UN convened a Committee on the Peaceful Uses of Outer Space (COPUOS), which was made a permanent committee of the UN General Assembly one year later and still functions. COPUOS has been the primary source for the drafting of international space Law.

The UN Outer Space Treaties

COPUOS began drafting a series of UN General Assembly resolutions in the early 1960s regarding outer space, culminating in what crystallized in 1967 as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty or OST).⁶ More than 100 States are Party to the OST,⁷ including major spacefaring nations such as Russia and China. The OST is the primary international legal instrument governing activities in outer space. This Treaty also provides the impetus for most nations around the world to draft their own domestic space laws and regulations.

The Treaty establishes several fundamental principles:

- the exploration and use of outer space shall be carried out for the benefit and in the interests of all States and shall be the province of all humankind;
- outer space shall be free for exploration and use by all States;
- outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means;
- States shall not place nuclear weapons or other weapons of mass destruction in orbit or on celestial bodies or station them in outer space in any other manner;
- the Moon and other celestial bodies shall be used exclusively for peaceful purposes;
- astronauts shall be regarded as the envoys of humankind;
- States shall be responsible for national space activities whether carried out by governmental or non-governmental entities;
- States shall be liable for damage caused by their space objects; and
- States shall avoid harmful contamination of space and celestial bodies.

The OST does not contain a definition or delimitation of “outer space.” It does, however, make clear that many of its terms apply to not only the celestial bodies themselves, but also to all of the “space” between them.

The OST was followed by four additional Space Law treaties over the next 13 years. The first of these, which concluded in 1968, was the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (Rescue Agreement).⁸ The OST and Rescue Agreement were followed by the Convention on International Liability for Damage Caused by Space Objects (Liability Convention) in 1972.⁹ This Convention addresses the question of liability for damage caused by space objects—absolute liability for damage “on the surface of Earth or to an aircraft in flight,” versus fault-based liability for damage caused in space.¹⁰ In 1974, another space-related treaty came into force, the Convention on Registration of Objects Launched into Outer Space (Registration Convention).¹¹ The Registration Convention creates an obligation to register spacecraft as a means to assist in the identification of space objects.

United States Space Laws

The U.S. supervises the activities of its nationals in outer space through a combination of statutes and regulations. These laws implement the international obligations undertaken pursuant to the Outer Space Treaties, including the requirement

⁶Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967), 610 *U.N.T.S.* 205, 18 *U.S.T.* 2410.

⁷The list on the status of international agreements relating to activities in outer space is compiled and distributed by the United Nations Office for Outer Space Affairs, available online at <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html>.

⁸Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (1968), 672 *U.N.T.S.* 119; 19 *U.S.T.* 7570; 7 *I.L.M.* 149 (1968).

⁹The Convention on International Liability for Damage Caused by Space Objects (1972), 961 *U.N.T.S.* 187; 24 *U.S.T.* 2389; 10 *I.L.M.* 965 (1971).

¹⁰*Ibid.*

¹¹Convention on Registration of Objects Launched into Outer Space (1974), 1023 *U.N.T.S.* 15; 28 *U.S.T.* 695; 14 *I.L.M.* 43 (1975).

in Article VI of the OST that States must provide “authorization and continuing supervision” of their nationals’ activities in outer space.

As noted previously, there are numerous Federal statutes that govern activities in outer space. For example, the Commercial Space Launch Competitiveness Act (CSLCA), which governs commercial space launch and reentry activities and is the primary focus of my testimony.¹² Other statutes include the Land Remote-Sensing Policy Act, which governs commercial remote sensing regulations by the Department of Commerce’s National Oceanic and Atmospheric Administration (NOAA) and the 1934 Communications Act, which created the Federal Communications Commission (FCC).

These various statutes authorize regulations that are found in the Code of Federal Regulations (CFR) and dictate the process for obtaining U.S. licenses to conduct space activities from the FAA, NOAA and FCC. U.S. space activities are also overseen by NASA and the Department of Defense (DOD), neither of which regulate commercial activities, though they do promulgate regulations governing their own activities.

Commercial Space Launch Act and FAA AST

The Federal Aviation Administration’s Office of Commercial Space Transportation (FAA AST)¹³ within the U.S. Department of Transportation (DOT) licenses commercial launch and reentry activities, as well as spaceports. Unlike the rest of FAA, which is authorized under Title 49 “Transportation,” of the United States Code, authority for FAA AST is located in Title 51, “National and Commercial Space Programs” and was established by the Commercial Space Launch Act of 1984 (CSLA).¹⁴ The CSLA was amended in 1988 to add an indemnification regime to limit exposure to third party liability claims. The first licensed commercial launches occurred in 1989.¹⁵ Significant amendments to the CSLA followed in 1998,¹⁶ 2004¹⁷ and 2015,¹⁸ to address reusable launch vehicles and reentry licensing; private human spaceflight; and resource utilization, respectively.

Licensing for Launch, Reentry and Spaceports

A license is required for a person or entity subject to the FAA AST’s jurisdiction “to launch a launch vehicle or to operate a launch site or reentry site, or to reenter a reentry vehicle, in the United States.”¹⁹ A license is also required for a “citizen of the United States”²⁰ when they are operating a launch, reentry or launch/reentry site outside the United States.²¹ Launch and reentry sites are also referred to as spaceports.²²

FAA’s regulations are largely focused on protecting the public. Commercial launches, reentries and spaceports may only be regulated, “to the extent necessary [. . .] to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security and

¹² See e.g., 51 U.S.C. §§ 50902–50923.

¹³ The Office of Commercial Space Transportation originally reported directly to the U.S. Transportation Secretary. In November 1995 during an agency reorganization, the Office of Commercial Space Transportation (FAA AST) was transferred from the Secretary’s office to the Federal Aviation Administration (FAA) as the FAA’s only space-focused line of business.

¹⁴ *About the Office of Commercial Space Transportation*, Federal Aviation Administration [hereinafter FAA], https://www.faa.gov/about/office_org/headquarters_offices/ast/. See, 51 U.S.C. § 50901–50923; Pub. L. No. 98–575; H.R. 3942, Commercial Space Launch Act, (Oct. 30, 1984) <https://www.congress.gov/bills/98th-congress/house-bill/3942>.

¹⁵ *Origins of the Commercial Space Industry*, FAA, https://www.faa.gov/about/history/milestones/media/commercial_space_industry.pdf.

¹⁶ Pub. L. 105–303.

¹⁷ Pub. L. 108–492.

¹⁸ Pub. L. 114–90.

¹⁹ 51 U.S.C. § 50904(a)(1).

²⁰ The definition for who is a “citizen of the United States” is uniquely defined by 51 U.S.C. § 50902(1)(A)–(C) as: “(A) an individual who is a citizen of the United States; (B) an entity organized or existing under the laws of the United States or a State; or (C) an entity organized or existing under the laws of a foreign country if the controlling interest (as defined by the Secretary of Transportation) is held by an individual or entity described in subclause (A) or (B) of this clause.”

²¹ 51 U.S.C. § 50904(a).

²² Part 420 of Title 14 of the Code of Federal Regulations governs launch site operator licenses (LSOL) site and Part 433 governs reentry site operator licenses (RSOL). A spaceport operator can obtain a LSOL and a RSOL for the same spaceport. A license to operate a launch and/or reentry site authorizes the licensee to offer its site to multiple operators. It does not include the license to perform the launch or the reentry. The vehicle operator seeking to conduct either of those activities must apply and receive a separate license under Part 450.

foreign policy interests of the United States.”²³ The primary focus of the licensing regulations and review is public safety, which requires the FAA to review the design, operation, and testing of a vehicle’s flight safety system as well as vehicle hazards, including debris, toxic release and overpressure.²⁴ Launches, reentries and spaceports are not regulated to protect the entities or people involved with the operations—the statute states that the FAA AST is not responsible for regulating to ensure mission success or to protect those people who are not defined as public.²⁵ That is intentionally different from the FAA’s regulation of aviation activities, which are regulated to protect the public as well as everyone involved in the flight, particularly paying passengers.²⁶ Additionally, FAA AST does not have statutory authority to regulate activities conducted on orbit; its authority is focused on public safety on Earth and in Earth’s navigable airspace.²⁷

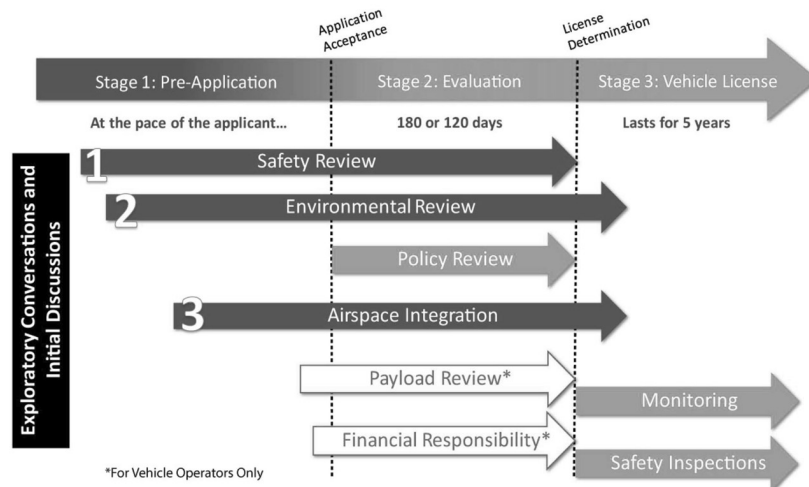


Figure 1. Process for Issuing Launch and Reentry Licenses.²⁸

The requirements for receiving a launch or reentry license are detailed in Chapter III, Part 450 of the Code of Federal Regulations, “Launch and Reentry License Requirement.”²⁹ Part 450 was published as a Final Rule in 2020 to streamline regulations that dated back to 1988. Members of industry raised significant concerns with certain aspects of Part 450 when it was published as a Proposed Rule as well as with the FAA’s approach to the rulemaking.³⁰

FAA’s Commercial Space Transportation Advisory Committee (COMSTAC) was tasked with reviewing Part 450 to identify aspects of the regulations that require additional clarification or a regulation change. That review identified a list of regulations that warrant clarification or change. Equally important, COMSTAC and industry members reported that Part 450 implementation is proving a significant challenge for the FAA and industry. Some of those issues are reflective of the down-

²³ 51 U.S.C. § 50901(a)(7).

²⁴ The Section 450.101 safety criteria include four categories: individual risk, collective risk, aircraft risk, and risk to critical assets. For example, the risk associated with launch or reentry to an individual member of the public must be less than one in one million ($E_c \leq 1 \times 10^{-6}$). Applicants must demonstrate how they will ensure that the public is excluded from the hazard area for the FAA to grant the license.

²⁵ The FAA defined “public” in § 401.5 of 14 C.F.R. 450, to mean “for a particular licensed or permitted launch or reentry, people that are not involved in supporting the launch or reentry and includes those people who may be located within the launch or reentry site, such as visitors, individuals providing goods or services not related to launch or reentry processing or flight, and any other operator and its personnel.”

²⁶ See, e.g., 49 U.S.C. § 106(g).

²⁷ H. Rept. 108–492, Commercial Space Launch Amendments Act of 2004; See, 150 Cong. Rec. H703, 2004.

²⁸ *Getting Started with Licensing*, FAA, https://www.faa.gov/space/licenses/licensing_process/

²⁹ 14 C.F.R. § 450.

³⁰ See Docket Number FAA–2019–0229, StrZeamlined Launch and Reentry Licensing Requirements.

side of performance-based regulations, which require the Federal agency to have the expertise and resources to efficiently review innovative approaches that may result in a higher level of safety, but deviate from past, more familiar approaches. Recommendations to address these problems include support for FAA's investment in process improvements and staffing in order to improve engineering and analysis expertise, communication, and accountability with regard to application review and status.

The elements of a Part 450 licensing process are shown in Figure 1. The time frame for Stages 1 and 2 regularly span two to three years or longer. To date, the FAA has only issued four licenses under Part 450 and has exceeded the 180-day review period for at least two of the four licenses, resulting in CSLA-required notices to this Committee.

Financial Responsibility and Indemnification

The Commercial Space Launch Act (CSLA) of 1984 included a requirement for licensees to carry liability insurance in an amount "necessary for the launch or operation, considering the international obligations of the United States."³¹ In the 1994 CSLA updates, the insurance requirements were expanded and an indemnification regime was added.³² That bill clarified the license requirement for obtaining insurance to cover third party and certain U.S. Government claims arising from the licensed activities as codified in 51 U.S.C. 50914, "Liability Insurance and Financial Responsibility." The required insurance is for claims by third parties—the uninjured public—and for damage to United States Government property. Damages have never exceeded the required insurance coverage, but if they did, the indemnification regime would be triggered. That regime currently expires September 30, 2025.

The financial responsibility regulations are codified in Part 440, *Financial Responsibility for Licensed Launch Activities*.³³ Earlier this year, the FAA recognized the challenges that industry and government stakeholders have faced with applying aspects of Part 440 and initiated an Aerospace Rulemaking Committee (SpARC). I commend the FAA in taking this step and am honored to serve as the industry lead for the Part 440 SpARC. Our efforts are focused on developing recommendations for regulatory reforms to Part 440 to address challenges such as launch cadences, innovative operations, a specialized and limited insurance market and missions that were not originally contemplated. The SpARC has the opportunity to help the FAA as it prepares to draft updates to the Part 440 regulations. A successful outcome will modernize requirements and ensure that the FAA's approach protects the public and U.S. Government interests while taking a rational approach to calculating financial responsibility requirements and implementing reciprocal waivers of claims.

Regulation of Human Spaceflight

In 1996, the X Prize Foundation offered \$10 million for the first non-government organization to launch a reusable crewed spacecraft into space twice within two weeks. In light of the interest in human spaceflight generated by the X Prize, as well as the successful demonstration by Scaled Composites,³⁴ Congress passed the 2004 CSLAA.³⁵ The CSLAA required that the FAA issue regulations relating to crew, space flight participants (SFPs), and permits for launch or reentry of reusable suborbital rockets. Additionally, the CSLAA introduced the concept of the "learning period."³⁶ Although the CSLAA granted the FAA authority over the safety of launch vehicles designed to carry humans, the "learning period" limited the FAA's ability to propose requirements governing the design or operation of a launch vehicle to protect the health and safety of certain people on board. The learning period was set to expire eight years after enactment, but has most recently been extended to January 1, 2024.³⁷

The CSLAA learning period does not limit all regulations regarding human spaceflight. For example, the FAA may regulate to protect crew members because they are part of a vehicle's flight safety system, which falls within FAA's public safe-

³¹ Pub. L. 98-575, § 16.

³² Pub. L. 103-272, § 70112.

³³ 14 C.F.R. § 440.

³⁴ In 2004, Scaled Composites won the X Prize by being the first to finance privately, build, and launch a vehicle able to carry three people to an altitude of 100 kilometers (62 statute miles). *Launching A New Space Industry*, X Prize, <https://www.xprize.org/prizes/ansari>.

³⁵ For a discussion of the law and political landscape surrounding the 2004 Space Act, see, Timothy Robert Hughes & Esta Rosenberg, *Space Travel Law (and Politics): The Evolution of the Commercial Space Launch Amendments Act of 2004*, 31 J. Space L. 1 (2005).

³⁶ 51 U.S.C. § 50905(c)(9).

³⁷ Pub. L. 118-15 § 2202(k)

ty authority. In accordance with the CSLAA, the FAA developed 14 C.F.R. part 460, which prescribes the human space flight requirements an operator must follow if a launch or reentry will occur with people on board the launch or reentry vehicle. For launch and reentry with crew, crew members must complete training in nominal and off-nominal conditions on how to carry out their role on board or on the ground so that the vehicle will not harm the public, demonstrate certain abilities during spaceflight and meet medical requirements.³⁸ Pilots and remote operators must satisfy certain additional requirements focused on an understanding of the vehicle and an understanding of operating safely in the National Airspace System (NAS). Finally, an operator is required to provide environmental control and life support systems adequate to sustain life and consciousness for all inhabited areas within a vehicle.³⁹

For launch and reentry with SFPs, an operator must train each SFP before flight on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exit.⁴⁰ Before receiving compensation or making an agreement to fly an SFP, an operator must inform the SFP in writing about the risks of launch and reentry, including the safety record of the launch or reentry vehicle type.⁴¹ The operator must also provide the SFP an opportunity to ask questions orally to better understand the risks and hazards of the mission.⁴² The SFP must provide consent in writing.⁴³ Finally, an SFP must execute a reciprocal waiver of claims with the FAA and the licensee in accordance with Part 440⁴⁴ and 51 U.S.C. 50914.⁴⁵

During the learning period, the FAA may also adopt regulations to restrict or prohibit design features or operating practices that (1) have resulted in a serious or fatal injury to persons on board during a licensed or permitted launch or reentry; or (2) contributed to an unplanned event or series of events during a licensed or permitted commercial human space flight that posed a high risk of causing a serious or fatal injury to persons on board.⁴⁶

In 2015, the Commercial Space Launch Competitiveness Act (CSLCA) extended the learning period to October 1, 2023, and directed the Secretary to “continue to work with the commercial space sector, including the [COMSTAC. . .], to facilitate the development of voluntary industry consensus standards based on recommended best practices to improve the safety of crew, government astronauts, and space flight participants as the [sector] continues to mature.”⁴⁷

Those efforts have been underway—industry has been developing consensus standards in the ASTM F47 Committee on Commercial Space. Additionally, the FAA has taken a step toward the development of regulations by initiating the Part 460 SpARC to review the existing regulations governing human space flight activities and in preparation for the learning period’s possible expiration. That Committee will develop consensus recommendations regarding future human space flight occupant safety regulations that will inform the FAA’s drafting of a future Notice of Proposed Rulemaking (NPRM).

The 2015 CSLCA also clarified FAA’s ability “to discuss potential regulatory approaches, potential performance standards, or any other topic related to [Section 50905(c)] with the commercial space industry, including observations, findings, and recommendations from the [COMSTAC], [. . .] prior to the issuance of a notice of proposed rulemaking.”⁴⁸

Today, the United States is home to the only commercial human spaceflight activities currently carrying private citizens on orbital and suborbital flights, as represented by the three companies participating in this hearing. Given the still limited developments in commercial human spaceflight, the on-going opportunities for thoughtful engagement between the FAA and industry as well as the FAA’s challenges with implementing its existing regulations, a learning period extension with

³⁸ 14 C.F.R. § 460.5(a), (b) & (e).

³⁹ 14 C.F.R. § 460.11. See also, *Environmental Control and Life Support Systems for Flight Crew and Space Flight Participants in Suborbital Space Flight*, FAA (Apr. 2010) https://www.faa.gov/about/office_org/headquarters_offices/ast/media/final_ECLSS_guide.pdf.

⁴⁰ 14 C.F.R. § 460.51.

⁴¹ 14 C.F.R. § 460.45(a).

⁴² 14 C.F.R. § 460.45(f).

⁴³ 14 C.F.R. § 460.45(f).

⁴⁴ 14 C.F.R. § 460.49.

⁴⁵ As part of the Commercial Space Launch Competitiveness Act passed in 2015, Congress added SFPs as applicable parties with whom a licensee must make a reciprocal waiver of claims. The FAA has not yet updated its regulations to reflect this addition. P.L. 114–119

⁴⁶ 51 U.S.C. § 50905(c)(2)(C).

⁴⁷ 51 U.S.C. § 50905(c)(3) & (9).

⁴⁸ 51 U.S.C. § 50905(c)(4).

direction for the FAA to engage meaningfully with industry to prepare for oversight responsibilities is warranted.

Mission Authorization for Novel Activities

U.S. space companies are rapidly innovating to bring new space capabilities to market for U.S. Government and non-government customers and, in many cases, leading the world in those efforts. Across the nation, there are a plethora of companies developing and demonstrating exciting in-space capabilities such as satellite servicing and maneuverability, private space stations, in-space manufacturing, nuclear power and propulsion technologies, and lunar rovers. U.S. policymakers should be preparing for these activities to evolve from being “novel” to defining our space capabilities. To foster those capabilities and U.S. competitiveness, companies are requesting regulatory certainty. This is not a new problem, but delays in solving it are having real consequences for the U.S. space industry and could affect our future space leadership.

The 2020 National Space Policy, as well as industry representatives and congressional legislation, have supported granting the Commerce Department’s Office of Space Commerce (OSC) the authority to approve U.S. commercial in-space and in-situ operations, referred to as novel or nontraditional activities.⁴⁹ The rationale supporting OSC as the primary authorizing agency is sound. The Commerce Department is already a regulator of in-space activities that focuses on fostering a robust U.S. industry while protecting national security and complying with our international treaty obligations.

Efficient and effective interagency interactions and consultations will be key to a minimally burdensome regime for authorizing in-space missions. The interagency process must involve significant accountability and transparency married with clear timeframes. The widely-supported self-certification approach is a good starting place as we guard against an approach that encourages companies to leave the United States. As stated earlier, it is vital that agency authorities be delegated in a manner that is appropriate to the in-space activities being authorized. Modeling an approach on the CSLA would be beneficial—it would ensure that near-term capabilities are appropriately reviewed in a timely and efficient manner and allow for expanding authorities as the industry develops. Instead of trying to predict all possible future technologies and potential risks, a flexible approach will ensure compliance with our treaty obligations, avoid being overly burdensome and foster our national security. Lastly, I encourage this Committee to continue to support a streamlined approach that avoids duplicative agency oversight, as it has since the 1994 CSLA.

* * *

I appreciate the invitation to testify before the Subcommittee today. These are exciting times for the U.S. space industry. My testimony has only scratched the surface of the space regulatory and policy landscape. U.S. space policy and legal oversight is extensive and is at its best when it effectively facilitates rapid technological and scientific advances while protecting public safety and national security interests. As the Committee considers commercial space legislation, it has the opportunity to continue U.S. leadership in diminishing regulatory uncertainty while facilitating continued space safety, innovation and competitiveness.

Senator SINEMA. Thank you. Our second witness today is Wayne Monteith. Mr. Monteith is the President and General Manager of National Aerospace Solutions and the Vice President of Bechtel National.

He was formerly the FAA Associate Administrator for Commercial Space Transportation and a Commander of Air Force Space launch activities. You are recognized for your opening statement.

⁴⁹The National Space Policy, 85 Fed. Reg. 81755 §5.3.a (Dec. 9, 2020); *Reopening the American Frontier: Exploring How the Outer Space Treaty Will Impact American Commerce and Settlement in Space*, U.S. Senate Committee on Commerce, Science and Transportation (May 23, 2017) <https://www.commerce.senate.gov/2017/5/reopening-the-american-frontier-exploring-how-the-outer-space-treaty-will-impact-american-commerce-and-settlement-in-space>; American Space Commerce Free Enterprise Act, H. R. 2809, 115 Cong. § 3 (2017).

**STATEMENT OF WAYNE MONTEITH, PRESIDENT AND
GENERAL MANAGER, NATIONAL AEROSPACE SOLUTIONS**

Mr. MONTEITH. Chair Sinema, Ranking Member Schmitt, and distinguished members of the Committee, thank you for inviting me to appear before this committee once again and share my perspectives on this important topic.

I am appearing today in my personal capacity, and I am not representing the views of any company, client, or Government entity. My views are heavily influenced by my 29 years of active duty service in the United States Air Force, culminating as the Commander of the 45th Space Wing in Florida, the busiest, most successful spaceport in the world, and my time as the previous FAA Associate Administrator for Commercial Space Transportation.

I last appeared before this committee in 2019. The number of FAA licensed commercial launch and reentry activities increased from 29 that year to 96 already this calendar year, more than tripling the cadence of activity. In terms of commercial human spaceflight, we went from one in 2019 to eight so far in 2023.

As impressive as these increases are, I expect it to be even more dramatic going forward as we continue to place more and more satellites on orbit, move from human adventure flights to on orbit habitats to the moon and beyond.

During the same timeframe, the FAA published a new streamlined launch and reentry regulation that was envisioned to enhance safety and have a lighter regulatory touch, while also being more flexible, accommodating to innovation, more responsive to the rapid pace of industry change and operational timelines, and less burdensome than the existing four regulations it was replacing.

Unfortunately, there are many in industry that would say this goal was not achieved. So, I remain concerned that continued growth will be negatively impacted by an overly burdensome or inefficient regulatory construct or a very public catastrophic event involving humans.

Sound or even perfect regulations and good intentions cannot eliminate all risk, but hastily develop regulations or an overly risk averse or understaffed regulator can sub-optimize or eliminate innovation, new entrants, and U.S. global leadership.

As the Committee considers the near and long term future of U.S. commercial spaceflight, I would like to offer three recommendations for consideration. First, I am not advocating for additional regulatory oversight on human spaceflight, but I do recommend that any change to the regulatory landscape be provided ample time for meaningful collaboration with industry, meaningful coordination within the interagency, and enough staff for the regulator to meet current obligations while providing the appropriate level of effort on the new regulation.

This would be a multi-year process to do correctly. Second, I believe a more efficient, one stop shop approach to authorizing and licensing space activities is necessary. In January 1984—in a January 1984 speech, then Secretary of Transportation Elizabeth Dole explained the President wanted to stimulate interest in commercial space ventures by removing regulatory barriers.

Secretary Dole said that companies trying to operate in space must go through as many as 17 agencies to get appropriate permits

and licenses. A one stop service would help them cut through the thicket of clearances, licenses, and regulations that keep industrial space vehicles tethered to their pads. I suggest we may not have completely solved the original problem that led to the creation of FAA AST.

Therefore, the Committee may wish to consider exploring opportunities to consolidate Government oversight responsibilities. Finally, as the Committee is well aware, the current regulatory construct for commercial human spaceflight is limited by the moratorium or learning period, originally established in 2004 and scheduled to sunset yet again in January.

The moratorium for the still nascent sector appropriately limits the FAA's regulatory oversight of the health and safety of commercial human spaceflight participants. Instead of extending the moratorium, I recommend that the Committee consider establishing a date in which a new regulation on commercial human spaceflight activities may not be published sooner than, and then establish a subsequent future date before the regulation could actually become effective.

The process can begin soon to fully and thoughtfully develop a regulation with industry, should it be needed, and allows Congress the option of delaying the effective date should the new rule be early to need.

Madam Chair, I appreciate your invitation to testify before the Committee. It is important that we work through these complex issues to ensure an appropriate level of safety and a light regulatory touch.

It is also important that whatever regulatory approach is taken, it enables our current industry leaders to continue to be safe and successful and allows for the next disruptive innovator to successfully enter the market. This will foster competition and help ensure the United States continues its global leadership in this vital transportation sector.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Monteith follows:]

PREPARED STATEMENT OF BRIGADIER GENERAL (USAF RET) WAYNE MONTEITH,¹
FORMER FAA ASSOCIATE ADMINISTRATOR, OFFICE OF COMMERCIAL SPACE
TRANSPORTATION

Chairwoman Sinema, Ranking Member Schmitt, and distinguished Members of the Committee: thank you for inviting me to appear before this Committee once again and share my perspectives on this important topic.

When I last appeared before you in 2019, I commented that in 2018 the Office of Commercial Space Transportation, or FAA AST, licensed a record number of launches and reentries at 35. I stated that I believed future growth in this sector would be even more impressive going forward as companies like SpaceX significantly expanded their launch rates and new companies like Rocket Lab and Firefly entered the sector. And because of this we needed a new, responsive, and flexible regulatory construct. One that would enhance safety while enabling innovation and continued U.S. global leadership. But also, one that would reduce administrative burden and enable rapid change and streamline timelines to keep pace with a burgeoning space industry. This prediction of future growth has come to fruition.

¹This testimony is provided in my personal capacity; it does not represent the views of my current employer, any company, client, or government entity. It does rely on my experience as the former Federal Aviation Administration Associate Administrator for Commercial Space Transportation, and as the former Commander of the United States Air Force 45th Space Wing.

The number of FAA AST licensed activities increased from 35 in 2018 to 84 in 2022, and 95 already in 2023. In 2019 there was one FAA licensed commercial human spaceflight mission; so far in 2023 there have been 8 flights, and that's even with a major contributor like Blue Origin temporarily pausing flight operations. My opinion of the future of this sector remains optimistic and I remain confident of continued innovation and dramatic growth in commercial human spaceflight.

However, this continued growth will be negatively impacted by either a catastrophic event or an overly burdensome regulatory construct. It will also be impacted by an overly risk-averse regulator, or even an understaffed regulatory office. These have the potential to unnecessarily restrict the success of the U.S. commercial space transportation industry, to include commercial human spaceflight. And while good regulations and intentions, and even overly conservative regulator interpretations of those regulations, cannot eliminate all risk, they can sub-optimize or eliminate innovation, new entrants, and U.S. global leadership. As the Committee considers the near-and long-term future of U.S. commercial human spaceflight, I would like to offer three recommendations to consider.

First, in May 2018 Space Policy Directive-2 directed the Department of Transportation to issue a new streamlined launch and reentry regulation. Just two and a half years later 14 CFR Part 450, the Streamlined Launch and Reentry Licensing Requirements regulation, or SLR2, was published. Part 450 encompassed four existing regulations (Parts 415, 417, 431 and 435) and was an unprecedented space regulatory effort. But based on the short development timeline, industry involvement in the regulatory process was severely limited. And because of this compressed schedule some constructs within Part 450 were not as thoroughly vetted as would have been ideal. Based on my experience during this effort, the Committee may wish to consider that any new regulations concerning commercial human spaceflight should be provided with ample time for full and open industry collaboration and inter-agency coordination, and sufficient government resources (*i.e.*, staffing) to meet required timelines without negatively impacting current regulatory responsibilities.

Second, there is another potential impediment to continued U.S. leadership in this sector and it is what appears to be a movement away from the concept of a "one stop shop" to receive a license or authorization to get to or operate in space. At just a casual glance the Office of Commercial Space Transportation, the Office of Space Commerce, the National Oceanic and Atmospheric Administration, the Federal Communications Commission, the National Transportation Safety Board, the Department of Defense, the State Department, and the National Aeronautics and Space Administration all have some role in commercial space activities. In my experience, the more organizations involved in an effort, the more likely seams, gaps, and overlaps are created. Additionally, there is an increase in administrative burden on both government and U.S. industry without a similar increase in safety. There is also the potential for greater government inefficiency, which will likely cause industry costs to increase, preventing new smaller, innovative companies from entering the market. Therefore, the Committee may wish to consider exploring whether or not there are opportunities to consolidate government oversight responsibilities.

Finally, as the Committee is well aware, the current construct for commercial human spaceflight is limited by the moratorium (learning period) originally established in 2004, extended four times by Congress, and scheduled to sunset again on 1 January 2024. Under this construct, Congress, with few exceptions, limits the FAA's regulatory oversight of the health and safety of commercial human spaceflight occupants. The FAA operates under an Informed Consent regime to ensure participants are fully aware of the risks and hazards involved. To support this learning period Congress prohibited the Secretary of Transportation from promulgating any regulations governing the design or operation of a launch vehicle intended to protect the health and safety of crew, government astronauts, and space flight participants absent serious or fatal injury, or an unplanned event that posed a high risk of serious or fatal injury. To be clear, the FAA does not certify launch or reentry vehicles as safe for carrying humans.

Instead, the FAA with help from the National Aeronautics and Space Administration (NASA) just produced an updated Recommended Practices for Human Spaceflight Occupant Safety. Recommended practices are divided into four categories: general, design, manufacturing, and operations. The FAA is working with Standards Development Organizations to facilitate development of consensus standards for industry to use which can form the foundation for any future rulemaking efforts. My observation is that while worthwhile, progress has been slow.

While I believe there is value in the consensus development process, I also believe that without a "forcing function" progress will remain slow, and the moratorium will continue until a catastrophic event occurs. That "forcing function" should drive greater industry/government participation and should include an increase in staffing

for the appropriate regulatory agency to properly build the foundation for an expanded regulatory construct. Based largely on my experience with Part 450, my concern remains a very public catastrophic event may drive a rush to regulate, and potentially over-regulate, this still nascent part of the industry. With this in mind, rather than a moratorium, the Committee may wish to consider a "forcing function" that instead establishes a date in which the FAA may not publish a more robust regulation on commercial human spaceflight activities sooner than, *i.e.*, in approximately five years (Phase 1). And then establish a subsequent date, a minimum of eighteen months later, before the updated regulation becomes effective (Phase 2). This approach allows time for an updated regulation to be fully and thoughtfully developed (Phase 1) and allows for the option of delaying the effective date (Phase 2) should Congress decide the regulation is "early to need." This approach may mitigate the downsides of publishing a hurried regulatory update as Phase 1 would potentially be complete.

Madam Chair, I appreciate your invitation to testify before the Committee. This is indeed the new renaissance of space, so it is important that we work through these complex issues to ensure an appropriate level of safety and a "light regulatory touch." It is also important that whatever the regulatory approach taken it enables our current industry leaders to be successful, and allows for the next disruptive innovator to successfully enter the market. This will foster competition and help ensure the United States continues its global leadership in this vital transportation sector.

Senator SINEMA. Thank you. Our next witness is Sirisha Bandla. Ms. Bandla is the President of Government Affairs and Research Operations for Virgin Galactic.

She is also the only panelist here today to have gone to space, flying on Virgin Galactic's Unity 22 mission. You are recognized for your opening statement.

**STATEMENT OF SIRISHA BANDLA, VICE PRESIDENT OF
GOVERNMENT AFFAIRS AND RESEARCH, VIRGIN GALACTIC**

Ms. BANDLA. Chair Sinema, Ranking Member Schmitt, thank you so much for the opportunity to speak today on behalf of Virgin Galactic.

The importance of this hearing is significant in furthering the progress of the commercial spaceflight industry, and we appreciate the scope and the attention of the Committee. Now, I have wanted to go to space since I was little.

I wanted to adventure out into the unknown as the captain of my own starship and follow in the footsteps of those that explored the stars before me, you know, Neil Armstrong, Sally Ride, Kalpana Chawla, Jean-Luc Picard.

But I have very bad eyesight and going to space in the way I had known it growing up through the NASA's astronaut corps was just not achievable until the advent of commercial human spaceflight, companies creating accessible and frequent access to space for anyone that wanted to experience it.

I joined Virgin Galactic in 2015. Galactic is the world's first commercial space line, pioneering human spaceflight for private individuals and researchers with its advanced air and space vehicles.

Galactic's vehicles have been designed to set new standards for human spaceflight safety, frequency, flexibility, and cost. Our company's mission is to democratize access to space to—by providing frequent private astronaut journeys, microgravity research, and space flight training opportunities.

Now, spaceflight is an experience that changes your perception and your view of life on Earth. I was lucky enough to embark on that experience with Virgin Galactic when I flew with five of my

crew members aboard our spaceship, VSS Unity, fulfilling a life-long dream.

And that is the hope, the mission, the vision of why we are all here to discuss current and future policies that could shape the growth of this industry, an industry that has the potential to open space access for researchers and scientists, that will further our understanding of our universe, our planet, and our place in it. An industry that has the potential to send more of our national and international astronaut corps to explore further destinations as humanity reaches further into the cosmos.

And an industry that can open space up for all, artists, educators, lawyers, Members of Congress and their staff, for anyone who wants to embark on the journey. While the U.S. has over 60 years of history in spaceflight and an immense database of spaceflight technology that many in industry, including Virgin Galactic, utilize, the commercial human spaceflight industry is relatively new.

Until recently, human spaceflight has primarily been in the domain of Governments, and access to space for humans was largely reserved for those in the national astronaut corps. To date, only 670 people have gone to space, and of those 670, only 64 were non-Government astronauts who flew on commercial vehicles, and many of them flew within the last 2 years. And the world is paying attention, though often with mistaken assumptions.

So, while one of the important discussions today will center around the learning period and human occupant safety, it is important for us to remember through our discussions that this industry is indeed regulated.

The FAA Office of Commercial Space Transportation regulates commercial space operations to protect public safety and property, and currently has a perfect safety record. This includes rules that cover the licensing and landing—the launch and landing operations, as well as governing the establishment of spaceports.

Intrinsically, regulating the vehicle for public safety does create a safer vehicle for the occupant. In addition, as the basis of our business, VG's highest priority is the safety of that of our crew and of our spaceflight participants.

Now, Congress acknowledged that it is impossible for regulators to create effective regulations for diverse, innovative vehicles without sufficient data and created a regulatory learning period during which the FAA may only regulate for the safety of the public or in response to an incident.

The rationale was that FAA regulatory burdens on a relatively new industry and rapidly evolving industry could slow innovation, particularly when it remains clear which areas FAA should regulate. And that is still true today. The learning period is currently scheduled to expire on January 1st, 2024.

However, due to technical and economic challenges of space flight and the industry's emphasis on safety above all, commercial space companies have proceeded at a more cautious pace than envisioned in the original bill.

And because of this, Galactic proposes extending the learning period to provide for a transition period utilizing collection of data

and a standard development process to properly inform future safety frameworks and what areas the FAA should indeed regulate.

The U.S. is leading the world in commercial human spaceflight, and the industry, while still in its infancy, is a beacon of innovation on and off this planet. I am looking forward to discussing those policies that will prioritize safety, while protecting the innovation that got us here today. Thank you.

[The prepared statement of Ms. Bandla follows:]

PREPARED STATEMENT OF SIRISHA BANDLA, VICE PRESIDENT OF GOVERNMENT
AFFAIRS AND RESEARCH OPERATIONS, VIRGIN GALACTIC

Chair Sinema, Ranking Member Schmitt, distinguished members of the Committee, thank you for the opportunity to submit testimony on behalf of Virgin Galactic, the world's first commercial spaceline. The importance of this hearing is significant in furthering the progress of the commercial spaceflight industry, and we appreciate the scope and attention of the Committee.

About Virgin Galactic

Founded in 2004, Virgin Galactic (VG) is the world's first commercial spaceline, pioneering human spaceflight for private individuals and researchers with its advanced air and space vehicles. Its vehicles are suborbital space labs for governments, researchers, and commercial industry to conduct research and test their innovations for the betterment of Earth and space exploration. VG's vehicles have been designed to set new standards for human spaceflight safety, frequency, flexibility, and cost. With a presence in California, New Mexico, and Arizona, our company's mission is to democratize access to space by providing frequent private astronaut journeys, microgravity research, and spaceflight training opportunities.

VG owns and operates its suborbital spaceflight system and draws its flight heritage from the historic SpaceShipOne spacecraft, which was the first private space vehicle to safely carry human beings into space claiming the Ansari X PRIZE in 2004. VG's spaceflight system opens frequent access to space and provides a transformational spaceflight experience to our astronauts.

VG's suborbital spaceflight system consists of two piloted vehicles, Mothership and Spaceship. Mothership is a four-engine, dual-fuselage jet aircraft capable of high-altitude, heavy-lift missions, including but not limited to fulfilling its role in carrying Spaceship to altitude. VG's spaceship is an air-launched, suborbital spaceplane designed to transport people and payloads safely and routinely to space and back. Spaceship's cabin comfortably seats four to six passengers or an equivalent mass and volume of science and technology payloads. In conjunction, these two vehicles allow access to space and regions of the atmosphere ranging from the troposphere to the thermosphere.

VG's current spaceship, VSS *Unity*, has flown nine private astronaut and research spaceflights. This includes the historic Unity 22 mission, which was the first fully crewed commercial spaceflight in the world, and Galactic 01, a dedicated research mission for the Italian Air Force (ItAF) and National Research Council of Italy, which flew three Italian government research specialists and over a dozen payloads to suborbital space. In addition, since beginning work with NASA's Flight Opportunities program, VG has flown a dozen research payloads for the agency.

2023 has been an exciting time for our company and for commercial human spaceflight, as we have flown five successful missions in five months, with a mix of research-dedicated, international partner, and private astronaut missions. VG's three private astronaut spaceflights for private astronaut purposes in 2023 included a flight with the first mother-daughter duo that have gone to space, an astronaut with Parkinsons, the first Pakistani to go to space, and the first astronauts from Antigua and Barbuda.

Our future will see VG expand our fleet of spaceships to increase access to space. In 2025, our new fleet of Delta class spaceships is expected to begin flight testing. Our new facility outside Phoenix, Arizona, will serve as the final assembly and checkout facility for the Delta fleet. The Delta class vehicle design is expected to increase performance and reduce time between flights. The introduction of these next-generation vehicles is an important milestone in Virgin Galactic's multi-year effort that targets flying 400 flights per year.

Commercial Human Spaceflight Activities

While the U.S. has more than 60 years of history in spaceflight, and an immense database of lessons learned on spaceflight technology and vehicle operations that many in industry, including VG, utilize, the commercial human spaceflight industry is still relatively new. Until recently, human spaceflight has been primarily in the domain of governments and access to space for humans has largely been reserved for those in national astronaut corps. To date, only 670 people have gone to space, and of those 670, only 64 were non-government astronauts who flew on commercial vehicles—the majority of which only flew within the last two years.

The emergence of commercial human spaceflight companies is changing the paradigm and aiming to democratize access to space for tourism and research purposes for private citizens, researchers, and government astronauts. The current human spaceflight industry is small and diverse—with vehicle systems ranging from spaceplanes to capsules. Companies are innovating not only through spaceflight technologies, but through manufacturing capabilities, ground operations, training programs, and more. The U.S. is leading the world in commercial human spaceflight and the industry, while still in its infancy, is a beacon of innovation on and off planet.

Current regulatory environment for human spaceflight is encouraging innovation and growth without compromising safety

The Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) regulates commercial space operations to protect public safety and property, and currently has a perfect safety record. This includes rules that cover licensing of launch and landing operations, as well as governance over the establishment of spaceports. Virgin Galactic has worked closely with the FAA throughout its licensing process and continues to do so during commercial spaceflight operations. As the basis of our business, VG's highest priority is the safety of our crew and spaceflight participants (SFPs).

Virgin Galactic operates a licensed human spaceflight system, with both mothership and spaceship always operating with two pilots onboard each vehicle. The spaceflight system is licensed under Title Part 400 regulations carried out by AST. VG's spaceflight system was first granted an Operator's license in 2016, which was later expanded in 2021 to allow the company to fly Spaceflight Participants (SFPs). This license—which is maintained throughout our operations for continued accuracy—is a clear and ongoing validation of our spaceflight system, which must meet the verification and validation criteria required by the FAA.

Virgin Galactic's mothership and spaceship also operate under Title 49 Part 91 airworthiness certificates administered by the FAA Flight Standards District Office, which include annual reviews and inspections of the vehicles, their operating limitations, and the FAA approved maintenance inspection program.

Congress acknowledged the emergence of the commercial human spaceflight industry, recognizing that it is in the 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 the 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 unclear which areas the FAA should regulate."

The Commercial Space Launch Amendments Act of 2004 established this regulatory learning period to enable human spaceflight operations to mature prior to FAA issuance of occupant safety regulations and to ensure that the agency had adequate time to develop the expertise and resources required for such regulations. Spaceflight participants operate under an informed consent and indemnification regimen that acknowledges the inherent risk and complexity of spaceflight, consistent with many other activities in the United States. The intent of the learning period is to allow the industry and the FAA to collect data that will allow for safe and effective human spaceflight regulations in the future. It is important to note that the current regulations that cover operations and public safety also provide indirectly for occupant safety. During this period, the FAA is still able to issue regulations governing the design or operation of a vehicle to protect the health and safety of crew, government astronauts, and spaceflight participants (under certain conditions).

Commercial human spaceflight readiness indicators for regulation indicate that the industry is not yet mature enough to drive a data-based regulatory framework

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 initially identifying the key metrics that may indicate the commercial space sector’s readiness for regulations. The FAA divided the indicators into three sets. In each of these three sets, it is clear the emerging commercial spaceflight industry is not yet mature enough for human occupant safety regulations.

1. 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 size and complexity of the industry is still maturing. For suborbital flights, the global industry only has one horizontal launch company, Virgin Galactic, and one vertical launch company, Blue Origin. So far, Virgin Galactic has nine human suborbital flights to space, while Blue Origin has conducted six. SpaceX is the U.S.’s only orbital commercial human spaceflight system and was primarily developed under contract to NASA to carry government astronauts to the International Space Station. Orbital spaceflight subjects human occupants to a much different spacecraft environment when compared to suborbital spaceflight. The industry is still small and diverse in its systems—and while commercial spaceflight has been around for many years, commercial *human* spaceflight is still very much nascent, with frequent flights only occurring in the last two years. Defining regulations that span diverse systems without first building a knowledge database has the potential to do more harm than good.

2. 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.

While the spaceflight industry, with active participation from the FAA and NASA, is making strong progress in developing consensus, performance-based safety standards that document industry and government-derived best practices for the benefit of the commercial space industry, there is more work to do. As industry grows and continues to collect data on human spaceflight operations, an organization and a process exists to continue the development of safety standards. ASTM International is a leading standards development organization with over 120 years of experience, and ASTM’s F47 Committee on Commercial Spaceflight is comprised of a variety of experts from government, industry, and academia. Subcommittees within the committee are working on multiple standards related to human spaceflight. However, with many companies have only recently begun frequent commercial operations, additional time is needed to continue to collect and analyze data for the purpose of developing a safety framework through industry consensus standards.

3. 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.

FAA AST is tasked with licensing and permitting commercial space launch and reentry. In recent years, commercial space industry growth has stretched AST’s licensing resources, and recent budget requests have included increased amounts to reflect this need. As launch demand increases, AST needs the resources, funding, and personnel to carry out the necessary workload for its primary authority. Until FAA is resourced and able to perform its principal duty effectively and in a timely manner, adding additional scope and workload has the potential to delay commercial spaceflight operations, risking the rapid growth the industry is undergoing.

Looking at the indicators FAA AST identified themselves, industry is not yet mature enough for effective and efficient human occupant safety regulations—but VG believes that it is the right time for government and industry discussions on future safety frameworks. VG, itself, has a robust framework for human occupant safety within our spaceflight system, built on industry and government best practices and the experience of our team. We look forward to participating and continuing to share best practices in the proper cross-cutting forum.

Extension of the Learning Period will allow industry time to develop a standards-based safety framework and create a transition period to a permanent future framework

This learning period is currently scheduled to expire on January 1, 2024, however, due to the technical and economic challenges of spaceflight and the industry’s emphasis on safety above all, commercial space companies have proceeded at a more cautious pace than envisioned in the original bill. As a result, there are only three companies currently carrying humans to space, and it would be premature to base occupant safety regulations on this extremely small set of data at this time.

VG proposes extending the learning period to provide for a transition period utilizing the collection of data and for the standards development process to properly inform future safety frameworks. This transition period should incorporate the development of an initial set of industry consensus standards that covers appropriate aspects of spaceflight participant safety, an evaluation of the practical applications of these standards, and an evaluation of FAA AST’s readiness to transition to a safety framework, including their execution of existing statutory requirements like launch and reentry licensing.

The transition period process would create a deadline for developing an initial set of industry consensus standards that covers appropriate aspects of spaceflight participant safety. The road mapping for an initial set of human occupant safety standards should be done through a standards development organization, such as those currently being developed by standards development organizations, primarily ASTM, and/or industry/government advisory group and would include FAA AST participation in the development and balloting process.

After the initial safety framework is completed through voluntary safety standards, operators will have a period of time to utilize and evaluate their effectiveness. Throughout the development and monitoring periods of this standards-based approach, FAA AST would engage with operators to collect feedback on the practical application of these standards to prepare for follow-on regulatory efforts. This will help the agency develop expertise and a roadmap. At the conclusion of the transition period, the learning period would be allowed to expire.

Increased funding for FAA AST is needed for AST to keep up with the growth of the commercial spaceflight industry and effectively transition to future regulatory reforms

Congress should reaffirm its commitment to safeguarding America’s leadership in commercial space launch and authorize the funding of the Office of Commercial Space Transportation at the level necessary to successfully fulfill its mission in an efficient and timely manner. Additionally, Congress should authorize research, engineering, and development funding for AST to develop a suite of tools to automate parts of the licensing process and help license evaluators handle the growing workload. Due to lack of additional resources, current resources are rightfully focused on licensing upcoming launch and re-entries—and should continue to do so. AST should first be adequately resourced to effectively and efficiently fulfill its current authority before looking to address future reforms.

Industry & government dialogue is important for the continued success of the commercial spaceflight industry

In the Commercial Space Launch Competitiveness Act of 2015 (CSLCA), Congress directed the FAA to “continue to work with the commercial space sector, including the Commercial Space Transportation Advisory Committee (COMSTAC) . . . to facilitate the development of voluntary consensus standards based on recommended best practices to improve the safety of crew, government astronauts, and space flight participants as the commercial space sector continues to mature.”¹ Congress further clarified that “nothing” in Title 51 § 50905 “shall be construed to limit the authority of the Secretary to discuss potential regulatory approaches, potential performance standards, or any other topic related to this subsection with the commercial space industry.”²

For many years, both FAA AST and COMSTAC have recognized the important role that the development of voluntary consensus standards can play to not only “improve the safety of the commercial human spaceflight industry as a whole,”³ but

¹ Commercial Space Launch Competitiveness Act of 2015, Pub. L. 114–90, § 111; 51 U.S.C. § 50905(c)(5) as amended [hereinafter CSLCA].

² *Id.* § 50905(c)(4).

³ Kelvin B. Coleman, Jennifer Bailey, Tara Halt, Rachita Puri, John Sloan, *Regulatory Preparation for U.S. Commercial Human Spaceflight*, 73rd International Astronautical Congress,

to also “help provide a baseline for compliance with potential future regulations covering human spaceflight”⁴ once the industry has reached sufficient operational cadence and technological maturity.

VG has worked with FAA AST since the company’s inception to secure and maintain the licensing of its spaceflight system. In addition, VG has participated in multiple advisory councils for AST to continue industry-government partnership in identifying and advancing policies and regulations that keep up with the ever-evolving industry. This includes participating in multiple Aerospace Rule-Making Committees (SPARCs) and advisory committees, such as COMSTAC.

In addition, FAA AST must continue to participate in industry dialogue and standards organizations. Nothing must be construed in future policies to restrict AST’s ability to engage in discussion on human spaceflight occupant safety while the learning period is still in effect.

Conclusion

This is an exciting time for not only Virgin Galactic, but for the entire industry as it continues to achieve milestones in human spaceflight. The Committee’s tireless work and progress on national and civil space policy is imperative and much appreciated by the public, the commercial spaceflight industry, and stakeholders. Thank you for holding this important hearing and Virgin Galactic looks forward to working with the Committee.

Senator SCHMITT. Thank you. Our next witness is William Gerstenmaier. Chair Sinema has Gerst in quotes. Is that appropriate? This is not my copy, but I am going to go ahead with Gerst. Take a leap of faith here. And is the Vice President of Build and Flight Reliability at SpaceX.

He previously spent over 40 years in public service, including overseeing human spaceflight efforts at NASA. Mr. Gerstenmaier, you are recognized for your opening statement.

STATEMENT OF WILLIAM H. GERSTENMAIER, VICE PRESIDENT, BUILD & FLIGHT RELIABILITY, SPACE EXPLORATION TECHNOLOGIES CORP. (SPACEX)

Mr. GERSTENMAIER. Madam Chair and Mr. Ranking Member, thank you for the opportunity to testify today. This is a critically important hearing. We are at an inflection point with incredible innovation in commercial space launch.

The criticality is especially true in the face of strategic competition from state actors like China. SpaceX is under contract with NASA to use Starship to land American astronauts on the moon before China does.

We are undertaking a campaign that requires many early test flights to rapidly mature and prove out the critical systems needed to safely land NASA astronauts on the lunar surface. We understand the vital importance of this national mission and the absolute need to protect the public during every phase of development.

Starship has been ready for its next flight test for more than a month, but we are waiting for an FAA license and accompanying interagency review. The Office of Commercial Space Transportation, known as AST, must recognize where the industry is, where the industry is going, and its role in regulating this emerging industry.

Sept. 18–22, 2022, available at https://www.faa.gov/sites/faa.gov/files/Regulatory_Preparation_Commercial_HSF%20FAA%20Coleman_IAC_Paris_B3_2%20Sept_2022.pdf.

⁴FAA, COMSTAC Recommendations for Human Spaceflight (HSF) Regulation, at 2, Nov. 2021, available at https://www.faa.gov/space/additional_information/comstac/media/HSF_Recommendation_Summary_Final.pdf.

Promote, encourage, enable, and protect public safety, this was Congress's direction to the Commercial Space Act when it was written. To do this, the pace of American regulation must match the pace of American innovation.

We are falling behind. I am privileged to lead a team of outstanding safety and reliability engineers at SpaceX. I also serve in the control room as SpaceX's Chief Engineer for three private Dragon flights with spaceflight participants.

Safety and reliability are everyone's responsibility at SpaceX and enables our current flight rate at about one launch every 4 days. Safety and reliability enable flight rate and do not inhibit. Regulations likewise can also be an enabler.

As it relates to the topic of this hearing, I want to be clear that Congress should pass a multiyear extension for the human spaceflight learning period. Human spaceflight represents a tiny fraction of all space launches and is properly regulated today under a responsible and balanced framework given the nascent state of the industry.

Much work is being done to think through what the future regulation may look like. We must get this right and it will take time. It would be premature by several years to let the learning period lapse, so I call on Congress to extend it.

With that said, I want to focus my testimony on AST's regulatory framework for launch and reentry licensing, which is in great distress. I want to state clearly that AST is an outstanding and important organization that needs more resources and immediate regulatory direction from Congress.

AST's role is critical to enabling safe space transportation, but we are at a breaking point. AST has neither the resources nor the flexibility to implement its regulatory obligations. Licensing, including environmental approval, often takes longer than rocket development. This should never happen, and it is only getting worse.

Our Starship, Falcon, and Dragon programs are encountering—are encountering regulatory headwinds and unnecessary bureaucracy that has nothing to do with public safety. Regulation is important, but so are the technical challenges associated with developing and operating transformative vehicle systems like Starship.

In my written statement, I offer several specific proposals for the Committee's consideration. As a summary, first, the AST Licensing Division needs at least twice the resources that they have today. We also recommend expedited hiring authority for AST to onboard additional qualified technical experts with an innovative mindset or to bring in outside help.

Second, AST's role is to promote—protect public safety, not to ensure success of rocket launches. Congress has been very clear about this. Space is not aviation. In space launch, as long as failure occurs safely, safe failure and rapid learning are often the fastest path to successful development.

Third, AST's Part 450 regulations need to change. When it comes to projects of national interest such as the Artemis program, Congress should establish a regulatory regime consistent with the national program objectives and schedules.

Other Government agencies that participate in AST licensing, like those with environmental responsibilities, should also be re-

quired to complete their work consistent with the national program schedules. I thank the Committee for convening this important hearing, and I look forward to your questions. Thank you.

[The prepared statement of Mr. Gerstenmaier follows:]

PREPARED STATEMENT OF WILLIAM H. GERSTENMAIER, VICE PRESIDENT, BUILD & FLIGHT RELIABILITY, SPACE EXPLORATION TECHNOLOGIES CORP. (SPACEX)

Chair Cantwell, Ranking Member Cruz, Chair Sinema, Ranking Member Schmitt, and Members of the Subcommittee, thank you for the opportunity to testify about modernizing and improving America's commercial spaceflight regulatory framework. The Committee's efforts and this timely hearing are critical particularly now as they relate to the Federal Aviation Administration (FAA) Office of Commercial Space Transportation's (AST) current approach to managing launch and reentry activities. This is a pivotal time for the commercial spaceflight industry and for American leadership. Your efforts in overseeing human spaceflight regulations and the transition to the new launch and reentry regulatory environment are critical. National policy for spaceflight must correctly recognize where the industry is, where it's going, and the role of regulators in this emerging and rapidly developing industry. Most of all, the pace of regulation must match the pace of American innovation.

As the world's leading space transportation and services provider, SpaceX maintains safe operations and public safety as our top priority. We share the Committee's commitment to ensuring the United States remains the world's leader in space. Unfortunately, under AST's present regulatory framework, serious problems are quickly mounting that will undermine American innovation while doing nothing to enhance public safety. Further, development of human spaceflight regulations also requires careful thought. Continuing the current learning period while smartly preparing for the eventual future of more expanded commercial human spaceflight activity is critical. At the same time, we must acknowledge the shortcomings of the present system and the volume of work coming, while reforming the regulatory process to move more efficiently. We urge the Committee to move quickly to address these challenges and facilitate an improved licensing framework and provide additional resources for AST.

I. Introduction

As Vice President for Build and Flight Reliability at SpaceX, my job is to ensure that SpaceX conducts its operations across the Falcon, Dragon, Starship, and Starlink programs safely and reliably for all of our U.S. Government and commercial customers. Prior to joining SpaceX in 2020, I served as the Associate Administrator of NASA's Human Exploration and Operations Mission Directorate (HEOMD), where I oversaw all of NASA's human spaceflight efforts, including the International Space Station (ISS), the Space Shuttle Program, Commercial Crew and Cargo, and many others, with a career in public service spanning over 40 years.

Today, I am privileged to lead the outstanding safety and reliability engineers who enable SpaceX to successfully launch our Falcon rockets every four days on average; to operate Dragon, the only operational orbital U.S. human spaceflight system, multiple times per year—enabling continued U.S. and International Partner presence in orbit without having to rely on Russia; and to help lead the next-generation of space launch technology development with Starship to land the next American astronauts on the Moon in the coming years. At SpaceX, safety and reliability is not just the responsibility of one organization; each employee carries a responsibility for safe and reliable operations. My organization's primary responsibility is to provide tools and a framework that the company's employees can use for safe and reliable spaceflight operations. Safety is at the core of SpaceX's ethos, and no company could successfully execute at our cadence and reliability without a fundamentally robust safety and mission assurance culture. Reliable system development and operations enable our current flight rate and diverse portfolio of activities.

We bring this culture and expertise to bear in our partnerships across the Government, including with AST. As a general matter, AST should be recognized for its hardworking, dedicated, and professional staff that work diligently to protect public safety during space launches and reentries. AST has an outstanding record of success in its core mission to protect the uninvolved public, and for this it should be commended. Its role in commercial space launch and reentry is critical to the success of the industry. If the U.S. is to continue to lead the world in space innovation; outmatch aggressive, state-backed Chinese competition; and enable new revolutionary technologies like Starship, the regulatory framework and AST will need to fundamentally change. The current system cannot match the pace of technological

leadership required by the private sector to keep the U.S. a leader in space exploration and national security. Innovation has returned launch capability to the U.S. and has provided new technologies that benefit national security. Starship has the potential to revolutionize launch, but regulations must be amended to allow for Starship to be successful. The technical challenges for Starship are significant, and the regulatory environment needs to enable technical innovation and not add undue burden to development that does not contribute to public safety. To be clear, SpaceX has an outstanding relationship with AST and highly respects the work it does for the industry and the country. However, much improvement is needed if the U.S. is to remain a leader.

Indeed, AST is the “gate” through which all U.S. commercial space launches and reentries must pass to achieve operational success. The line at this gate has become unsustainably long, and AST is now facing the very real prospect that it is slowing rather than enabling U.S. progress in spaceflight capability. As such, it is imperative that Congress take quick action to address very specific challenges inhibiting AST’s ability to more efficiently perform its core function. It should be quickly provided with the necessary resources to do its job more efficiently and in keeping with industry progress. And AST itself must embrace responsible improvements to its processes in order to meet its growing mandate. Otherwise, the United States faces regulatory paralysis that will stifle the abundant innovation and capability that the private sector is bringing to market. This paralysis will harm programs of national significance like Artemis and threaten the current U.S. leadership in launch and reentry capabilities.

II. SpaceX in 2023

SpaceX was founded in 2002 to expand space access and to improve the reliability and affordability of space transportation. Today, SpaceX is the world’s most active launch services provider, having successfully launched spacecraft to orbit and beyond 270 times, including 73 launches in 2023 to-date. SpaceX has also conducted 41 orbital reentries with our Dragon spacecraft and 235 successful first stage landings. At present, we launch a rocket roughly every four days from U.S. soil. This is an unprecedented pace in the history of rocketry. The recent Falcon Heavy launch of NASA’s Psyche mission to a metallic asteroid with both boosters returning to safely land at Cape Canaveral continues to inspire. Reusability is a key enabler for SpaceX. Starship’s fully reusable first and second stages will be a significant advancement in reusability. Starship needs both reusability and reliability to be successful. In order to gain reliability, a rapid flight pace is needed.

SpaceX is proud to serve the Nation’s space enterprise with satellite launches for NASA, DOD, the IC, and other Federal agencies, and is certified to conduct 100 percent of U.S. Government mission requirements under the NASA Launch Services Program (LSP) and the National Security Space Launch (NSSL) Program. In close partnership with NASA, SpaceX developed the Dragon spacecraft to support crew and cargo transportation to and from the ISS. Since 2012, we have performed 28 un-crewed cargo resupply flights to and from ISS. In 2020, SpaceX restored America’s human spaceflight access after nearly a decade of national reliance on Russia. We have successfully conducted seven crewed missions for NASA to and from ISS since then, with another six-month mission underway today and more planned in the years to come.

All of SpaceX’s innovation occurs in the United States, creating tens of thousands of direct and indirect jobs, advancing technology, and generating substantial economic activity. SpaceX invests billions of dollars across the country in development, test, operations, and supplier purchasing from crucial (and largely small business) vendors across America. We maintain manufacturing and engineering facilities in Hawthorne, CA; Starlink satellite system design and manufacturing facilities in Redmond, WA; a rocket development and test facility in McGregor, TX; and launch pads and rocket processing facilities within Cape Canaveral Space Force Station, NASA Kennedy Space Center, and Vandenberg Space Force Base; and production, test, and launch facilities at Starbase in South Texas. SpaceX maintains a network of more than 7,000 American suppliers—supporting 150,000 small business jobs—and vendors in all 50 states.

To advance the next generation of space transportation technology, SpaceX is developing Starship, the largest, most powerful space vehicle system in history. With its unique, revolutionary design, Starship will be fully and rapidly reusable, capable of delivering astronauts and more than 100 tons of usable cargo to orbit, the Moon, and Mars. This capability is an order of magnitude more than any other launch system previously developed. The Starship program is ambitious, by design. To prove out the system, SpaceX has conducted 12 low-and high-altitude test flights since 2019 from our Starbase development, production, and launch site near Brownsville,

Texas, including the first fully integrated flight in April 2023. We are prepared to conduct Starship's second integrated test flight as soon as the end of this month, pending only FAA license approval, which includes the reviews of supporting agencies. Critically, the vehicle has been ready to fly since mid-September. The current regulatory process is not keeping up with the pace of innovation.

In 2021, NASA competitively awarded SpaceX the Human Landing System (HLS) contract to help return American astronauts to the Moon as part of the Artemis Program, and subsequently awarded a follow-on crewed lunar mission in 2022.¹ SpaceX is diligently working to maintain schedule for NASA in the face of global competition with China. NASA Administrator Bill Nelson has urged expediency, noting: "[i]t is a fact: we're in a space race [with China]."² Though these launches are for NASA, the FAA is responsible for licensing all test and operational launches. SpaceX is also under contract with the U.S. Air Force to use Starship to support the Vanguard Rocket Cargo Program.³ Starship represents an area where the U.S. Government does not appear to be aligned across agencies with its own objectives. While NASA and DOD are rightly focused on development schedule and national need, SpaceX faces continual and increasing test and operational headwinds as it relates to AST and other Federal agencies. Various regulatory agencies must be aligned on mission to truly enable critical and timely advancements in space technology that are required for the U.S. Government to be successful in reaching its own objectives.

Starship is further critical to the deployment of next-generation Starlink and Starshield capability, which are crucial to expanding broadband access and to U.S. national security and foreign policy objectives abroad. Starlink and Starshield build on the company's experience in launch vehicle and spacecraft design, development, production, and on-orbit operations. Operating in low Earth orbit (LEO), Starlink provides high-speed, low latency broadband to commercial users in all 50 states and around the world, and today serves over two million households and businesses. By focusing service on households that previously lacked access to reliable broadband service, Starlink is helping to rapidly address the digital divide. And with Starshield, SpaceX is applying Starlink technology and launch capability to support vital national security efforts for the DOD.

By operating in LEO, systems like Starlink provide much faster speeds and lower latency than traditional satellite communications systems operating in higher orbits, and can support far more users. However, this closer altitude necessitates deploying thousands of satellites over hundreds of launches to provide consistent global coverage, which requires a regulatory regime capable of consistently and efficiently licensing launches at unprecedented scale. Other countries are moving forward with significant investment in LEO space systems, and are clearing regulatory obstacles to allow for their state-backed networks to rapidly launch and deploy. For example, China is aggressively pursuing a satellite constellation with plans to launch approximately 13,000 satellites in the coming years.⁴ The European Union is also pursuing its own Secure Connectivity LEO system, as are Russia and India. Launch licensing regulatory challenges are not "top of mind" for these countries as they race to compete with U.S. commercial technology—regulatory challenges only appear to be an obstacle for launch companies in the U.S. To be clear, the United States does not need to set aside its regulatory obligations or its commitment to public safety; a smart, appropriately resourced system can both meet these needs *and* facilitate innovation.

In order to successfully execute on its commitments, SpaceX plans to conduct at least two more Starship flights this year, with a higher flight rate in 2024 and beyond, plus an estimated 30 more Falcon flights for various customers, including the U.S. Government, before the end of the year. This test and flight cadence across multiple vehicle families for SpaceX alone is almost certainly not possible if Congress does not provide AST with additional resources, direction, and legislative guidance. Unnecessary overhead will delay the technology advances needed to keep the U.S. as a leader in space. The public needs to be protected, but the private sector

¹"NASA Awards SpaceX Second Contract Option for Artemis Moon Landing," *NASA.gov*, November 15, 2022, accessed at <https://www.nasa.gov/humans-in-space/nasa-awards-spacex-second-contract-option-for-artemis-moon-landing/>

²"We better watch out: NASA boss sounds alarm on Chinese moon ambitions," *POLITICO*, January 1, 2023, accessed at <https://www.politico.com/news/2023/01/01/we-better-watch-out-nasa-boss-sounds-alarm-on-chinese-moon-ambitions-00075803#:~:text=So%20says%20NASA%20Administrator%20Bill,astronaut%20said%20in%20an%20interview.>

³"Rocket Cargo—FA8650-22-9-9301," *SAM.gov*, January 14, 2022, accessed at <https://sam.gov/opp/1bd5d826c1e74a4abee083dde1652348/view>

⁴"China is developing plans for a 13,000-satellite megaconstellation," *SpaceNews*, April 21, 2021, accessed at <https://spacenews.com/china-is-developing-plans-for-a-13000-satellite-communications-megaconstellation>

needs to be enabled to explore, learn, and develop new technologies at a rapid pace. As the human spaceflight industry emerges, care must be taken to not overburden development with new regulations. The U.S. public needs to be protected both by regulation and innovation. If the U.S. loses its technological advantage to other countries, the public is also at risk. The nation that leads in technology sets the standards for all others to follow. We cannot risk loss of technical leadership because of an antiquated regulatory environment. An innovative and agile approach to regulations is as important as technological advancement.

III. AST Modernization and Change

The Committee is taking on important work across the full range of space policy issues from establishing a balanced, responsible mission authorization process to maintaining a sustainable orbital environment. SpaceX strongly supports all of this work and looks forward to working with the Committee as it formulates policy. As noted, however, the Committee must first place its focus on AST and launch and reentry licensing reforms, which is the *sine qua non* for every other regulated activity related to U.S. space activities.

While nearly the entire rest of the world relies on state-owned or state-sponsored entities, the United States derives nearly all of its competitiveness in space from the domestic commercial sector. Indeed, U.S. Government launch capability for NASA, DOD, and the IC is almost exclusively provided by commercial launch providers as a service. The Commercial Space Launch Act of 1984 established the Nation's launch and reentry regulatory framework, which appropriately prioritized protecting public safety while maximizing innovation:

“the United States should encourage private sector launches and associated services and, *only to the extent necessary*, regulate such launches and services in order to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security interests and foreign policy interests of the United States.”⁵

Congress has consistently recognized over several decades that “there is an inherent risk in spaceflight.”⁶ Accordingly, it has directed that the regulatory regime for commercial space launch and reentry focus on protecting *public* safety, rather than attempting to perform mission assurance or otherwise ensure the success of a space launch or reentry. To be clear, it is expressly *not* the purpose of AST to prevent launches or reentry from failing. Commercial space regulations *are not* akin to aviation regulations and have been developed purposefully to limit AST's role in this respect. The fact that commercial space is regulated by FAA versus any other Federal agency is incidental, but the comingling of AST within FAA's broader priorities of regulating commercial aviation—where FAA must regulate to ensure the success of airline flights—creates undue confusion regarding AST's role.

While AST has achieved admirable success ensuring public safety, it is reaching a breaking point as it relates to timely license issuance, even for “routine” missions on mature launch vehicle systems like the Falcon 9. With respect to innovative systems in development, including those that are critical to key national objectives like NASA's Artemis program, AST licensing is now the critical path watch item that is at risk of slowing the pace of innovation and program execution. For example, the Starship Flight 2 launch vehicle has been ready to fly since mid-September in order to test critical systems needed to meet NASA objectives, and is simply awaiting AST licensing approval. This is the consequence of several concurrent challenges, including:

- (1) AST's transition to “streamlined,” performance-based regulations under Part 450 has resulted in delayed agency guidance, confusion, and uncertainty both for the regulated entity and the regulator. In September 2020, AST updated its regulations in an attempt to reform the licensing process and keep pace with the growth of the launch industry. While well-intentioned, the Part 450 effort has not succeeded in accomplishing a streamlined process. AST's ability to process licenses in a timely fashion has declined rather than improved—indeed, as evidenced by licensing for the handful of applicants under Part 450,

⁵ Emphasis added. “H.R. 3942—98th Congress (1983–1984): Commercial Space Launch Act,” *Congress.gov*, October 30, 1984, accessed at <https://www.congress.gov/bill/98th-congress/house-bill/3942>

⁶ “H.R. 5382—108th Congress (2003–2004): Commercial Space Launch Amendments Act of 2004,” *Congress.gov*, December 23, 2004, accessed at <https://www.congress.gov/bill/108th-congress/house-bill/5382>; “H.R. 2262—114th Congress (2015–2016) Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015: Report,” *Govinfo.gov*, May 18, 2015, accessed at <https://www.govinfo.gov/content/pkg/CRPT-114hrpt119/pdf/CRPT-114hrpt119.pdf>

approval timelines are not improving. For example, the Starship license for Flight 1 took nearly three years. These delays are contrary to the intent of Part 450 itself, and this situation is untenable.

AST's delay in issuing clear guidance results largely from resource constraints—its overburdened staff have rightly focused on the growing pile of license applications, and have little time to think cohesively about implementation and policy development with respect to Part 450. The Commercial Space Transportation Advisory Committee (COMSTAC) issued consensus recommendations to AST on this issue, and Congress should encourage AST to move forward on those recommendations.

- (2) AST as a whole—and particularly its Licensing Division—is substantially under-resourced. With its limited staff, the AST Licensing Division is often constrained as to how it allocates its resources and must pull qualified analysts from one application or internal program to focus on another—resulting in delays for both. Currently, AST is only able to review license material sequentially (rather than in parallel). A license applicant is forced to “pick and choose” which of its programs should be prioritized in order to help manage AST's workload. This places both AST and its licensees in an impossible position, particularly for licensees who work multiple programs important to the Government—what should be prioritized? Vehicle operators should not be in a position of deferring license work or disrupting business operations in order to alleviate AST workload.
- (3) AST's regulatory approach is often non-agile and inflexible, contrary to national policy which requires both. Indeed, the National Space Policy mandates that agencies must “[c]reate transparent regulatory processes that minimize, consistent with national security and public safety, the regulatory burden and uncertainty for commercial space activities and that are flexible. . .”⁷ AST must do more to enable flexibility in its regulations, particularly for mature launch and reentry systems and launch sites. In many cases, both have been otherwise approved by NASA or the United States Space Force (USSF), but AST's interpretation of its regulatory compliance obligations forces duplicative and unnecessary paperwork that does not contribute to public safety and is not in the national interest.

The above reflect status quo challenges. But, as AST transitions licenses for vehicles previously approved under legacy regulations to Part 450 over the next two years, the entire regulatory system is at risk of collapse. AST is struggling to fulfill its responsibilities today and simply does not have the bandwidth to process the significant additional paperwork of this transition without materially reducing its responsiveness to applicants. This is not a hypothetical—AST's workload over the next 12–24 months could result in the grounding of U.S. space launch capability if action is not taken immediately.

SpaceX recommends Congress take steps immediately to modernize the current launch and reentry licensing regime and provide additional resources and tools to aid AST in its mission.

IV. Rapid Technology Development

America's greatest strength against well-organized, state-sponsored foreign competition that has no respect for intellectual property is its entrepreneurial system that enables and encourages rapid, continuous private sector innovation. Here, SpaceX takes a spiral development approach across all of our programs, which prioritizes rapid design, early test article build, and frequent real-world flight testing early in the development process. SpaceX uses this approach across all of our complex space system development programs, including Falcon 9, Dragon, Falcon Heavy, Merlin and Raptor engine development, and Starlink. And it has yielded unprecedented successes. In every case, this approach proved to be less expensive, faster, and more successful than any comparable aerospace development approach, in most cases by orders of magnitude.

Testing development hardware in a flight environment enables our teams to quickly learn and execute design changes and hardware upgrades necessary to improve the probability of success in the future. At all phases of development and operation, SpaceX takes every precaution to ensure public safety, but we will take programmatic risk during testing to advance technology—just as the United States did through much of the Space Race. Public risk and programmatic risk are not the same and are not in conflict—we (and our customers) are responsible for pro-

⁷ “National Space Policy of the United States of America,” *Office of Space Commerce*, December 9, 2020, accessed at <https://www.space.commerce.gov/policy/national-space-policy/>

grammatic risk. AST is responsible for ensuring that our efforts to protect public safety are verified and appropriate. Both are achieved with success simultaneously.

SpaceX works closely with federal, state, and local agencies, including AST, to protect public safety and the safety of the SpaceX workforce. This philosophy has proven highly successful. Our Falcon family of launch vehicles are now the most flown in the United States by far and the most reliable space vehicles in history.⁸ Globally, Falcon is the only vehicle system able to keep pace with a similar high cadence of launch in China. And, from a mass-to-orbit perspective, which is the most important metric when evaluating capability, Falcon alone outperforms China three to one. Without this speed of innovation, China would outperform the United States by far today. Excluding SpaceX, China launched nearly three times more than the rest of U.S. industry *combined* in the first half of 2023, and carried *almost eight times* more mass to orbit than all other U.S. launch operators.⁹

Most recently, however, this paradigm seems to be failing. AST's approach to Starship appears out of family with its general approach for both SpaceX and other vehicle licensing among U.S. systems that SpaceX is aware of. For example, with Falcon, the iterative design process was aptly demonstrated by SpaceX's approach to *learn* how to recover and reuse rockets, which is a huge advantage to the United States. Here, from 2012 to 2015, SpaceX undertook a development effort to prove out orbital vehicle reusability, a capability long held to be impossible for an orbital-class rocket stage. This development campaign, which progressed from suborbital to orbital experiments (much like Starship) included at first many low and high-altitude flight tests in quick succession across several hardware versions of the launch system, some of which resulted in a loss of vehicle, and then recovery attempts following successful orbital launches of Falcon 9. At every stage of the process, we widely publicized and celebrated these tests—including failures—which we used to learn and then apply those learnings to the vehicle.¹⁰

SpaceX conducted all of these tests safely. We were permitted to *learn through flight*. We implemented learnings quickly, returned to flight quickly, and learned more. And then we achieved success with Falcon. Today, since the first successful recovery of a Falcon first stage in December 2015, SpaceX has now successfully recovered a Falcon booster 235 times and re-flown our rockets 207 times, transforming the economics of space access. The United States is the *only* country that has this capability today—not China, not Russia, not Europe. This success would not have been possible without rapid development, rapid flights, and timely licensing from AST. SpaceX is following the same approach with Starlink and Starship today, but we are not experiencing the same licensing approach from AST.

V. Launch and Reentry Licensing

To address these challenges, SpaceX proposes specific improvements to the regulatory process for launch and reentry that are vital to ensuring America's continued global leadership and competitiveness in space. Specifically:

- (1) *Provide AST with significantly more resources (at least 2x) and expedited hiring authority* to move quickly to bring onboard additional, qualified technical experts to keep pace with license review. These resources should be *specifically (and only)* authorized and appropriated for the AST Licensing Division. Additionally, more resources will be for naught if AST is unable to timely and efficiently hire—Congress should empower AST to use expedited hiring authorities to rapidly grow its workforce.
- (2) *Provide AST with new authorities to enable license applicants to self-fund qualified, third-party technical organizations* to bolster and expedite AST license review where needed.
- (3) *Provide AST with additional resources and direct AST personnel to travel to launch operator locations to conduct in-person Technical Interchange Meetings (TIM) on-site with license applicants.* In-person TIMs are a highly productive and efficient mechanism to clarify technical matters associated with license applications, and to see hardware and launch infrastructure in order to gain an understanding of proposed activities and verifications.

⁸“The Falcon 9 may now be the safest rocket ever launched,” *Ars Technica*, February 3, 2022, accessed at <https://arstechnica.com/science/2022/02/spacex-falcon-9-rocket-has-set-a-record-for-most-consecutive-successes/>

⁹“Global Orbital Space Launches Q1 2023,” *BryceTech*, n.d., accessed at https://brycetechnology.com/reports/report-documents/Bryce_Briefing_2023_Q1.pdf; “Global Orbital Space Launches Q2 2023,” *BryceTech*, n.d., accessed at https://brycetechnology.com/reports/report-documents/Bryce_Briefing_2023_Q2.pdf

¹⁰“How Not to Land an Orbital Rocket Booster,” *SpaceX*, September 14, 2017, accessed at <https://www.youtube.com/watch?v=bvim4rsNHkQ>

- (4) *Establish shorter mandatory timelines to initiate review, conduct interagency consultations, and complete license applications, and eliminate the tolling loophole. The license application process should be electronic and automated to the maximum extent possible.*
- (5) *Direct clarity updates to Part 450 and establish standard, expedited processes for regular and routine license application review, especially for mature vehicles that launch or reenter frequently.* Each license application review today is a bespoke effort, even for vehicles and profiles that have flown many times previously. AST should have tiers of review based on operator and vehicle experience and maturity. AST's advisory circulars (ACs) relating to Part 450 are intended to provide guidance to both applicants and reviews, but in many cases they either do not exist or simply reincorporate processes from legacy regulations—which are overly conservative and prescriptive. The regulatory uncertainty associated with Part 450 implementation is driving unnecessary burden for both industry and AST. And, the prescriptive and conservative nature of the Part 450 ACs that have been published render them inapplicable when evaluating unique, innovative vehicle features that companies are introducing to add capability, reduce costs, and improve safety. Properly structured regulations should instead encourage technical progress by laying out a clear, responsible path to applicants in advance to achieve compliance.
- (6) *Direct AST to focus only on public safety, not mission success. This is an absolutely critical element of space launch and re-entry licensing that has been lost in interpretation. As noted, AST is not responsible for mission assurance, nor is it qualified to perform this function.* Congress has specifically identified public safety as the sole objective of launch and reentry licensing, but the vague and interpretive nature of Part 450 has led to regulatory overreach, where reviewers now devote significant time and resources to consider factors unrelated to public safety and outside the scope and intent of Part 450.
- (7) *Provide authority to expediently issue waivers to outmoded requirements that do not impact public safety.*
- (8) *Accelerate environmental reviews by extending existing authority used for airports to space launch and reentry infrastructure, and to provide expedited review for projects of national interest and national security.*
- (9) *Establish an accelerated regulatory path, potentially independent of AST, for development and for experimental missions that support national requirements like the Artemis Program.* This option would align AST's mission with that of broader national priorities. AST's current experimental authorities should be enhanced to capture innovative system development, particular for those under contract to perform work for the U.S. Government.
- (10) *Align external regulatory timelines and reviews.* Under the National Environmental Policy Act (NEPA) and other relevant laws, AST is often responsible for conducting environmental consultations relating to its licensed activities with other Federal and state agencies. Here, review timelines and requirements are misaligned and incongruent. Congress should implement common sense procedural changes to align inter-agency review schedules, enforce deadlines, and provide expedited review for commercial space projects of national interest or national security.

VI. Human Spaceflight Regulations

Following the first SpaceShipOne flights in 2004, Congress passed the Commercial Space Launch Amendments Act (CSLAA) of 2004.¹¹ This legislation appropriately established a comprehensive framework intended not to regulate for mission success, but rather “to put in place a clear and balanced regulatory regime that promotes the development of the emerging commercial human space flight industry, while protecting the public health and safety.”¹² This structure, which remains in place today, incorporated three key elements:

- *An informed consent regime.* The bill affirmed the “inherent risk” of any type of spaceflight—commercial or Government—in acknowledgement of the fundamental differences between space launch and reentry and any mode of common carriage transportation (e.g., commercial aviation). Space vehicle operators must provide significant information to prospective space flight participants about general risks, the vehicle in question, and the operator's safety record.

¹¹H.R. 5382 (108th)

¹²*Id.*

Space flight participants must accept these risks in writing. *Informed consent is a common legal practice, and it is in use for many adventure sports, including skydiving with more than 3.9 million jumps in the United States in 2022.*¹³ The informed consent regime has been very effective in both ensuring public safety and allowing industry development.

- *Occupant safety regulations intended to protect public safety.* The 2004 CSLAA requires DOT to issue regulations to ensure safe operation of a vehicle in order to protect public safety. To-date, AST has published regulations relating to training and medical condition, environmental control and life support systems, fire suppression and smoke detection, and various other human factors. AST's approach has been appropriate to date based on regulatory authority and industry development.
- *Learning Period.* The CSLAA properly established the human spaceflight "learning period," often colloquially (and incorrectly) referred to as a "moratorium," that appropriately limits AST from promulgating additional regulations relative to occupant safety during launch and reentry until both industry and AST have sufficient experience and data to consider whether a different safety framework is required. The learning period originally ran through 2012, but has been subsequently extended several times and now is set to expire January 1, 2024. Even with the learning period in place, the law permits AST to promulgate regulations to restrict or prohibit design features that resulted in a serious or fatal injury or that posed a high risk of causing a serious or fatal injury during a licensed or permitted commercial human spaceflight. The law also does not require AST to promulgate human spaceflight regulations on any particular timeline, or at all for that matter.

SpaceX recommends that Congress extend the human spaceflight learning period. The current learning period expiration date of January 1, 2024 is premature by several years, and the same factors that led Congress to extend the learning period in 2012 and 2015 remain true today. As an initial matter, based on the above, AST is simply not in a position to effectively regulate in this area, nor should it. Both the scope of the industry and the number of flights with private individuals remain very low, and the existing occupant safety requirements under FAA Part 460 effectively protect the public. At this stage of development, informed consent is appropriate and protects the occupants since spaceflight today is completely unlike commercial passenger aircraft transport. Industry is still developing concepts and hardware with orbital, sub-orbital, and balloon systems.

Additionally, not only does AST lack specific expertise in human spaceflight systems, it is completely overwhelmed in executing its core launch and reentry mission. AST has neither the resources nor the expertise to develop regulations in the near-future, and transferring funds or personnel from its public safety obligations would serve only to compound the challenges AST is facing in licensing launch and reentry operations and would not improve safety. If anything, Congress should reiterate and reinforce that AST must exclusively focus on protecting the public during launches and reentries, and hold AST accountable for doing so. Congress should approve a multi-year extension of the learning period and support the consensus standards development effort underway today on human spaceflight safety.

Even if AST were adequately processing applications for launches and reentries in a timely fashion, it is unprepared to implement human spaceflight regulations today or in the next several years. DOT only just formally established an Aerospace Rulemaking Committee (SpARC) designed to *initiate* consultation with industry and other experts in this area. The process to produce a report alone is expected to take at least two years, and most likely longer, plus additional time for Congress, AST, and stakeholders to evaluate any recommendations. The very reason DOT convened a SpARC is to *learn* what it should potentially do as it relates to human spaceflight, which could include extending the learning period further. A lapse in the learning period at the very time this SpARC is conducting its work would be the wrong policy outcome.

The Committee should understand that AST's execution of its public safety obligations for launch and reentry licensing is *totally dissimilar* from FAA's implementation of aircraft safety statutory obligations under a completely unrelated set of statutes, regulations, and mission objectives. While FAA has technical authority in aviation safety and the protection of airline passengers, it does not have similar expertise in spaceflight technical systems beyond public safety. It has never been AST's

¹³"How safe is skydiving?," *United States Parachute Association*, n.d., accessed at <https://www.uspa.org/discover/faqs/safety#:~:text=Skydiving%20is%20a%20popular%20sport,of%2092%20jumps%20per%20member>.

job to evaluate the flightworthiness of space systems—nor should it be. AST’s job is to ensure that, if a failure with a spaceflight system occurs, it does not harm the uninvolved public, either persons or property. The differences from aircraft worthiness in one case to public safety in the other are vast and will remain so for many years.

Regulations on commercial space were very deliberately constructed in this way. The accompanying bill report to the 2015 CSLCA noted that “[w]ithout launching and operating commercial human spaceflights, industry and regulators have limited data to inform safety regulations, which could lead to uninformed or unnecessary regulations that would stifle the growing industry.”¹⁴ This remains true today—indeed, not much has changed since 2015 except a handful of flights from a total of three operators, only one orbital.

- While SpaceX has conducted many uncrewed satellite launches for commercial customers, the broader U.S. launch industry is primarily still developing new systems, which have only recently begun launches or may begin to do so over the coming years.
- There have been very few commercial human spaceflight missions without government astronauts—a total of three to orbit, and all on a system (Dragon) certified by NASA. While Congress and industry anticipated many missions with paying private customers to occur in the years immediately following the passage of the 2004 CSLAA, this did not occur. In reality, there were zero private human spaceflights to sub-orbit or orbit between 2005 and 2021. SpaceX remains the only domestic provider of operational human spaceflight to orbit and has conducted three total missions with a total of 12 space flight participants since 2021. There are only two operational providers of sub-orbital private missions (Blue Origin and Virgin Galactic), who collectively have conducted 11 missions with spaceflight participants since 2021.¹⁵ This is the very definition of a nascent industry. By comparison, there are more than 45,000 commercial aviation flights in the United States *every day* that collectively carry 2.9 million passengers, and evidently 3.9 million sky dives annually that remain regulated under an informed consent regime.¹⁶
- Human spaceflight vehicle designs remain fundamentally different from each other—including capsules, winged vehicles, lifting bodies, balloons, automated systems, manually-piloted systems, and others. Unlike aircraft, there is no consensus on space vehicle design or operation, making any common regulatory approach untenable today to both the operator and the Government.
- Both launch vehicles and spacecraft are early in their design cycles and continue to see significant changes in design and operational concepts. This rapid iteration is necessary to eventually get to a future with airplane-like operations. Otherwise, premature occupant safety regulations risk freezing the industry in an early stage, slowing or inhibiting the development of technologies that would materially improve safety.
- There are no accepted metrics to evaluate the readiness of either FAA or industry to proceed to a different regulatory structure, as noted by COMSTAC.
- The 2015 CSLCA encouraged the commercial space sector, with AST facilitation, to develop voluntary industry consensus standards. This development has been far slower than Congress anticipated due to limited market, operational experience, and vehicle systems, including zero flights with space flight participants until six years after the law was passed. However, development has accelerated over the past year. There are now 10 published human spaceflight standards, and others that are in development. A comprehensive set of consensus standards may be available by the end of the decade. Congress should allow this process to unfold before providing AST with preemptory authority that would be ill-informed without the completion of this process.

Continued industry development, completion of consensus standards, and the ongoing work of the Part 460 SpARC, and AST’s fundamental lack of resources all demonstrate the need for Congress to pass a multi-year extension of the learning period.

¹⁴H.R. 2262 (114th)

¹⁵“List of human spaceflights, 2021–present,” *Wikipedia*, n.d., accessed at https://en.wikipedia.org/w/index.php?title=List_of_human_spaceflights,_2021%E2%80%93present&oldid=1178938297

¹⁶“Air Traffic by the Numbers,” *FAA.gov*, April 2023, accessed at https://www.faa.gov/air_traffic/by_the_numbers

VII. Conclusion

SpaceX respectfully urges the Committee to take action to keep the U.S. as the world's leader in spaceflight during this pivotal time. Action is important not only to SpaceX, but to the industry as a whole. U.S. leadership and the well-being of all Americans hinge on appropriate action. The private sector is working hard to support the Nation, but it needs the help of Congress and regulatory agencies. AST can be both an enabler of safe spaceflight and one of innovation. Its role in executing its licensing functions and promoting the U.S. commercial launch industry has never been more important, and it is at a crossroads. SpaceX respectfully urges the Committee to help AST perform its statutory obligations given the rapid pace of growth in this industry. Given the challenges of its limited workforce and inflexible interpretation of regulatory requirements, U.S. leadership in space will suffer without action. SpaceX thanks the Committee for convening this hearing. We stand ready to help the Committee take productive action on these issues in the remaining months of this year.

Please contact Michael.Lapidus@spacex.com with any questions or if we can provide any additional information.

Senator SCHMITT. Thank you. Our final witness is Phil Joyce. Mr. Joyce is the Senior Vice President of the New Shepard Business Unit at Blue Origin.

He has spent over four decades in aerospace and defense working, including a focus on human spaceflight and launch vehicle development. Mr. Joyce, you are recognized for your opening statement.

STATEMENT OF PHIL JOYCE, SENIOR VICE PRESIDENT OF THE NEW SHEPARD BUSINESS UNIT, BLUE ORIGIN

Mr. JOYCE. Chair Sinema, Ranking Member Schmitt, thank you for the opportunity to speak with you today. Blue Origin's team is focused on radically reducing the cost of access to space, harnessing its vast resources, and inspiring future generations.

We build and operate reusable rocket engines and launch vehicles, in-space systems, and lunar landers. The products we create will enable our vision of millions of people living and working in space for the benefit of Earth, a vision that must be built on a foundation of safety, innovation, and competition.

At Blue Origin, we recognize that the U.S. Government is a critical partner in advancing our vision. On July 20th, 2021, our new Shepard suborbital rocket completed its first commercial human spaceflight, safely caring four humans above the Karman line and back to Earth.

This milestone was made possible by a deliberate step by step test and verification program conducted over many years with a singular focus on safety. Since then, New Shepard has flown 5 percent of the world's population of astronauts above the Karman line, and almost 9 percent of the women, and many firsts for humans in space.

Our astronauts return to Earth forever transformed by their experience and share this with the rest of the world to inspire positive change. Since the dawn of the space age, humans in space have united the planet and there is no time like the present to remind us how critical this is for humanity.

The first step to an enduring human presence in space is launch. The FAA's authority in this area is clear and its regulatory powers are extensive. Blue Origin and the other companies here provide

the FAA with comprehensive data about our systems and processes to ensure the safety of the uninvolved public and property.

A recent experience partnering with the FAA to investigate a mishap on an uncrewed New Shepard flight is an example of the effectiveness of the current regulations. Our flight safety systems worked as designed, and the FAA was able to efficiently verify this due to the insights we have provided through the licensing process.

To continue promoting safety and innovation, the FAA needs three things. First, the FAA needs a more streamlined process. To keep pace with industry, both the substance and administration of launch regulations should be improved.

We encourage Congress to support the FAA's effort to generate guidance, process, tools, and training. This will allow the FAA to use their staff more efficiently without adding unnecessary burdens to operators.

Second, the FAA needs sufficient resources to keep up with licensing. Congress and the FAA helped accelerate the development of the commercial spaceflight industry, and now the FAA is struggling to keep pace.

Streamline processes will help, but the FAA needs more funding to deal with the increase in launches. This is a great problem to have. It is why you passed the Commercial Space Launch Act in the first place.

Third, the FAA needs time. The learning period is an opportunity for the FAA to gain experience in human spaceflight before it regulates further. The learning period should be extended. The FAA should be encouraged to talk to industry, build consensus, and scale up its licensing capabilities. In the meantime, launch operations such as New Shepard will continue, and this will provide valuable insight to the FAA and the industry.

Beyond the FAA, Congress should think broadly about how to build a framework for mission authorization that should be correctly scoped and draw clear boundaries between agencies. We also recommend Congress designate a single agency as the hub for authorization of commercial space activity.

In conclusion, commercial human spaceflight is an American success story in progress. Congress has an opportunity to help write the next chapter and spur continued innovation in the space economy. From launch to the moon and beyond, U.S. leadership is a necessity.

To cement our role, we need a competitive regulatory environment, one that realizes the potential for commercial investment alongside our civil and national security initiatives. We look forward to making progress toward the dream of millions of people living and working in space for the benefit of Earth. Thank you for the opportunity to testify today.

[The prepared statement of Mr. Joyce follows:]

PREPARED STATEMENT OF PHIL JOYCE, SENIOR VICE PRESIDENT,
NEW SHEPARD BUSINESS UNIT, BLUE ORIGIN

Chair Sinema, Ranking Member Schmitt, and members of the Subcommittee, thank you for the opportunity to speak with you today about commercial human spaceflight, a topic that is fundamental to Blue Origin's near and long-term vision.

THE FUTURE OF HUMAN SPACEFLIGHT AT BLUE ORIGIN

Blue Origin is building a road to space for the benefit of Earth. Our team is focused on radically reducing the cost of access, harnessing its vast resources, and inspiring future generations. We build and operate reusable rocket engines and launch vehicles, in-space systems, and lunar landers. Blue Origin has grown into a company of more than 10,000 employees, with facilities in seven states and a nationwide supply chain. The vehicles and in-space systems we create will enable our vision of millions of people living and working in space, a vision that relies on the principles of safety, innovation, and competition. Blue Origin's astronauts return to Earth forever changed by their experience and share this with the rest of the world as champions of space for the benefit of Earth.

NEW SHEPARD—SUBORBITAL LAUNCH

On July 20, 2021, Blue Origin's New Shepard suborbital rocket completed its first commercial human spaceflight, safely carrying four humans above the Kármán line and back to Earth. Since then, New Shepard has flown 5 percent of the world's astronauts above the Kármán line, 9 percent of the women, and many firsts for humans in space. We expect to fly more than 1,000 humans to space in the coming years.

Safety is—and always will be—Blue Origin's highest priority. These milestones in human flight were preceded by years of a deliberate, step-by-step test and verification program with a singular focus on safety. Blue Origin has been flight testing the New Shepard rocket and its redundant safety systems since 2012. The program has had 22 successful consecutive missions, including three successful escape tests, showing that the crew escape system can activate safely in any phase of flight. This safety system was activated during the most recent uncrewed New Shepard mission in an unplanned event and performed flawlessly.

The foundation of New Shepard's safety architecture is a design and verification process that incorporates best industry practice from aerospace and other safety-critical industries. New Shepard's crew capsule was designed with numerous redundant safety systems that provide layers of protection to our astronaut crews. For example, the capsule can land with only one of its three parachutes deployed, as the landing deceleration system, crushable ring on the bottom of the capsule, and seats designed to absorb g-forces all act as back-up systems to slow the capsule and allow it to land astronauts safely. This attention to detail in our safety system design is a result of our culture, which puts safety at the forefront of all our operations.

NEW GLENN—ORBITAL LAUNCH

As the New Shepard program gains experience through design, build, test, and operation, lessons learned have been and continue to be applied to New Glenn, Blue Origin's orbital launch vehicle. These lessons have been particularly beneficial in the areas of autonomy, guidance, vertical landing architecture, powerful and throttleable liquid engines, and lean operations. New Glenn's reusable first stage is built for a minimum of 25 missions and though early operations are devoted to payload launch, the vehicle is also engineered with the safety and redundancy required to fly humans. New Glenn is purpose-built to deliver high volume and mass to orbit and is a key to unlocking our long-term vision—a future where people and heavy industries can work in space to preserve Earth, humanity's blue origin.

ORBITAL REEF—COMMERCIAL SPACE STATION

Orbital Reef will revolutionize human spaceflight in low Earth orbit (LEO). This unique destination will provide the essential infrastructure needed to scale economic activity and open new markets in space. The next era of the space station will go beyond research to include entertainment, tourism, and so much more. Attached modules of many types can experiment with any type of business, including: government-sponsored space research; industrial operations ranging from entertainment and advertising to filmmaking, sports, and gaming, to applications research and manufacturing; passenger travel starting with adventure travel, then evolving to tourism and orbital living.

In the near future, LEO will be the logical place to mature technology, train astronauts, conduct science, and inspire students. This means we need to assure access for crew and cargo, preserve a sustainable working environment free of orbital debris, and prioritize investments in next-generation research capabilities.

LUNAR LANDER

Lunar permanence has been core to Blue Origin's vision since the beginning. We are a proud partner with NASA on the Artemis program, building the Sustaining

Lunar Development lander to take astronauts back to the Moon and create a sustainable human presence.

Blue Origin's lunar lander and supporting systems are the foundational elements of our broader architecture to enable our vision of building a road to space for the benefit of Earth. To realize the value of the Moon's potential, secure a sustained lunar presence, and achieve Blue's goal of lunar permanence, we need reliable, recurring lunar transportation.

GOVERNMENT STAKEHOLDERS IN HUMAN SPACEFLIGHT

LAUNCH

The Federal Aviation Administration's (FAA) Office of Commercial Space Transportation (AST) is responsible for regulating the U.S. commercial space transportation industry, "to ensure compliance with international obligations of the United States, and to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States."¹

Human Spaceflight Regulation

In 2004, the Commercial Space Launch Amendments Act (CSLAA) was passed by Congress and granted the Secretary of Transportation the authority to regulate launch and reentry of commercial spacecraft carrying humans.² This legislation provided limitations to ensure that a nascent industry and its regulator were able to build experience in human spaceflight safety. These limitations, known as the 'learning period,' require that no safety regulations for design features or operating practices can be promulgated unless they are created after an event resulting in a serious or fatal injury (or the risk of such an injury). In response to this congressional action, the FAA published Title 14 of the Code of Federal Regulations (CFR) Part 460.

Part 460 does address some aspects of occupant safety, including requirements to protect crew members who are essential to a vehicle's flight safety system and therefore public safety. These include training and environmental controls that guard the crew's ability to carry out safety-critical tasks, as well as additional requirements for pilots and remote operators.³ Space flight participants (SFPs) are required to be trained for emergency conditions and are informed in detail as to the risks of spaceflight.⁴ This process, known as 'informed consent,' requires operators to communicate safety records throughout the history of spaceflight, including all known hazards and risks associated with their mission, and acknowledge there are unknown hazards associated with spaceflight. Written documentation is followed by an opportunity to ask oral questions to ensure risks are well understood.

Launch & Reentry Regulations

All launch activity, regardless of humans on board, requires a license from the FAA. Licensing is performed under the regulations found in 14 CFR Part 450, though legacy operators may hold active licenses under the legacy requirements of Part 431 (Reusable Launch Vehicles) and Part 415 (Expendable Launch Vehicle). Part 450 is a result of Space Policy Directive-2 (SPD-2)⁵ published in 2018 which directed a review and revision of launch and re-entry licensing for the purpose of streamlining. The policy requires a single license for all operations and the use of primarily performance-based criteria.

Blue Origin and many other industry stakeholders were, and continue to be, extremely supportive of the goals of SPD-2. After an accelerated rulemaking process, the FAA published the Part 450 regulations which became effective in March 2021. As of July 2023, only four licenses have been granted.⁶ The implementation of these regulations is discussed in the policy recommendations of this testimony.

IN-SPACE ACTIVITY

Article VI of the Outer Space Treaty states that "[t]he activities of non-governmental entities in outer space . . . shall require authorization and continuing super-

¹ 51 U.S.C. § 50901(a)(7). See also "About the Office of Commercial Space Transportation" https://www.faa.gov/about/office_org/headquarters_offices/ast

² Pub. L. 108-492

³ 14 C.F.R. § 460.5 through § 460.5-13

⁴ 14 C.F.R. § 460.45 and § 460.51,

⁵ See "Space Policy Directive-2, Streamlining Regulations on Commercial Use of Space", May 24 2018 <https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-2-streamlining-regulations-commercial-use-space/>

⁶ See "COMSTAC Regulatory Working Group Report, Part 450—Challenges and Recommendations" July 11, 2023 <https://www.faa.gov/media/68016>

vision by the appropriate State Party to the Treaty.”⁷ The United States currently does not vest a single agency with that authority.

Activities in space are currently monitored and licensed by numerous U.S. government agencies to satisfy this obligation. The Federal Communications Commission (FCC) licenses satellites and earth stations for space-based services and is responsible for allocation of spectrum for all public and private actors. The National Oceanic and Atmospheric Administration (NOAA) Commercial Remote Sensing Regulatory Affairs Office (CRSRA) licenses operations of commercial imaging satellites. The Department of Defense (DoD) currently provides monitoring and Space Situational Awareness (SSA) services for commercial operators on orbit. The Office of Space Commerce (OSC) has begun work on a parallel SSA service in anticipation of transitioning these responsibilities from the DoD. Lastly, FAA commercial space launch licenses require advanced review of all payloads for potential impacts to national security, international obligations, and foreign policy through an interagency process known as a Payload Determination.

NASA

The National Aeronautics and Space Administration (NASA) does not have regulatory authority over commercial human spaceflight, but NASA plays an important role as a stakeholder in U.S. space activity. NASA’s Commercial Crew Program has successfully utilized commercial services for launch to the International Space Station (ISS) since 2020. While these launches are licensed by the FAA, NASA maintains responsibility for Crew Safety outside of the FAA’s Part 460 Regulations.

NASA is also engaging with commercial industry’s suborbital vehicle programs through an effort known as Suborbital Crew (SubC). For this program, NASA has changed its approach to managing the safety of their personnel.⁸ Rather than requiring formal certification programs, companies must present a “safety case” that explains their internal safety processes, which NASA will evaluate to make a determination.

POLICY RECOMMENDATIONS TO ENABLE CONTINUED SAFETY, INNOVATION, COMPETITION

EXTEND THE LEARNING PERIOD

The learning period has had a positive impact on the development of commercial human spaceflight, including at Blue Origin. This provision is set to expire on January 1, 2024 and Congress should act with urgency to provide an extension that will allow industry and the FAA to demonstrate readiness for potential next steps.

Industry Learning & Readiness

The human spaceflight learning period has been in statute since 2005, but the first FAA-licensed launch with a paying customer on board was New Shepard’s first human flight in July 2021. As of October 18, 2023, only 22 commercial human flights have been licensed for three providers, along with seven NASA human spaceflight missions.⁹ Blue Origin is proud to be a part of this onset of activity, but it does not by itself demand further regulation. Instead, gathering invaluable flight data and experience from multiple providers and technologies begins a critical phase of learning under the learning period.

Safety frameworks for spaceflight can be robust while also evolving. As flight and test experience grows, new data can validate requirements or identify areas for improvement. The ability to react to new information and iterate within tools, processes, and criteria, strengthens the commercial industry’s contributions toward innovation. Gains in both efficiency and safety are the spirit of innovation that can open access to space and maintain U.S. leadership.

FAA Learning & Readiness

A dynamic, evolving industry needs to be supported by an equally agile regulator. Congress made it clear that the FAA has a responsibility to use the learning period to prepare:

⁷ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967), 610 U.N.T.S. 205, 18 U.S.T. 2410.

⁸ See “Commercial Programs” NASA Advisory Committee Meeting, May 2023 Slide 14 <https://www.nasa.gov/wp-content/uploads/2023/10/csd-nac-briefing-may-2023-tagged.pdf>

⁹ Number of licensed flights updated for recent activity, See Report to Congress “U.S. Department of Transportation Evaluation of Commercial Human Space Flight Activities Most Appropriate for New Safety Framework” Sept. 2023, https://www.faa.gov/sites/faa.gov/files/PL_114-90_Sec_111_7_Commercial_Human_Spaceflight_Activities.pdf

“Nothing in this subsection shall be construed to limit the authority of the Secretary to discuss potential regulatory approaches, potential performance standards, or any other topic related to this subsection with the commercial space industry, including observations, findings, and recommendations from the Commercial Space Transportation Advisory Committee, or its successor organization, prior to the issuance of a notice of proposed rulemaking.”¹⁰

The FAA, through the Commercial Space Transportation Advisory Committee (COMSTAC) and their exposure to commercial operations, has begun to engage with industry, but Congress should continue to encourage and support these actions. Blue Origin advocates that the following two forums for should be leveraged further by the FAA.

First, the FAA should continue to increase its engagement in the industry consensus standards process as required in statute.¹¹ While operators, academics, and associations develop content, the FAA can facilitate discussions on how standards might be used in the future, and where they have successfully been used in the past. The FAA has insights into safety procedures across the industry, giving them an opportunity to nudge industry in the most helpful directions. This could have a powerful impact on prioritization of efforts for the commercial space voluntary consensus standards.

Second, the FAA AST recently chartered an Aerospace Rulemaking Committee (“SpARC”) to request industry guidance on occupant safety.¹² Blue Origin is proud to be a member of this committee and looks forward to contributing our thoughts. The charter is open for 24 months, and initial industry recommendations are due after the first year. We recommend that the FAA take advantage of the full charter duration, review report content, ask questions, debate with industry, and conclude the process with a well understood path forward. Recommendations from the SpARC should feed into measurable FAA AST plans for future regulatory action. These plans should include workforce needs, tool improvements, and a roadmap for guidance documents, including industry standards and Advisory Circulars (AC).

The three U.S. commercial human spaceflight launch providers operating today have three fundamentally different architectures: suborbital and orbital; piloted, autonomous, and hybrid; vertical and horizontal takeoff and landing. There is no one-size-fits-all criteria for safety in a market as diverse as human spaceflight. A prospective regulatory framework needs to be results-oriented rather than prescriptive because the means of compliance to meet the requirement are likely to vary by mission profile and design choices.

As more operators apply for, or transition to, licenses under the newest regulations in Part 450, the FAA AST has an opportunity to demonstrate success of a flexible, performance-based regime. Metrics from this process can be regularly reported to Congress to evaluate readiness for the sunset of the learning period. The learning period should remain in place until reports show decreasing review timelines, increasing throughput in all licensing phases (*i.e.*, pre-application, complete enough, final review), increasing cadence of AC publication and AC updates, and increasing transparency into the licensing process.

CONDUCT STREAMLINING EFFORTS FOR LAUNCH LICENSING

The FAA faces near-term challenges with implementing these critical public safety regulations given the increasing volume of prospective launch providers and cadence of launches. During the December 2022 COMSTAC meeting, it was indicated there was a backlog in licensing and that the FAA AST will need to prioritize work and put some license applications in a queue prior to assessment.¹³ Difficulties in implementing Part 450 regulations only exacerbate this workload. The FAA requested specific feedback from the COMSTAC on potential improvements to the Part 450 regime in May of 2023.¹⁴

Blue Origin greatly appreciates FAA’s desire to continuously improve processes, eliminate duplication and inefficiencies, and appropriately allocate limited resources. Congress can support these efforts by allowing the FAA to invest in and

¹⁰ 51 U.S.C. § 50905(c)(5)

¹¹ 51 U.S.C. § 50905(c)(3)

¹² See “Human Space Flight Occupant Safety Aerospace Rulemaking Committee Charter” March. 24, 2023 https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/Final-ARM-220523-001_S1%20Signed.pdf

¹³ See summary of remarks made by Associate Administrator Coleman, “Meeting Minutes” Dec. 15 2022 https://www.faa.gov/sites/faa.gov/files/COMSTAC_Meeting_Minutes_Fall-2022.pdf

¹⁴ See “COMSTAC” May 15 2023, p. 55–63 https://www.faa.gov/space/additionalinformation/comstac/May_15_2023_PM.pdf

develop a suite of tools to automate the most cumbersome manual tasks done today by license evaluators. These tools could be the fastest way to realize a reduction in processing timelines and provide transparency to applicants. Further review of Part 450 implementation should include identification of key roles and expertise required to evaluate license applications in a performance-based framework. Solutions must consider a strategy for hiring and training of these roles while considering attrition estimates and availability of personnel with the requisite qualifications in the larger workforce.

Innovation needs to exist in our vehicles *and* our regulatory processes if the U.S. is to maintain our competitiveness in the global launch market. Blue Origin looks forward to continuing to work with Congress and the FAA to identify these opportunities.

DEFINE MISSION AUTHORIZATION & APPLY LESSONS LEARNED

Despite the need for continued streamlining and modernization of their role, the FAA's launch and reentry authority has been clear for over 30 years, providing commercial entities clarity and certainty as they enter the market. The same cannot be said for the growing body of capabilities being developed for orbital, cislunar, and lunar ecosystems, which go far beyond transportation. The lack of a single authority over space objects and activities other than launch, telecommunications, or remote sensing has led to several challenges as executive agencies attempt to exercise partial authority in the absence of congressional clarity. Where interagency processes have been used to compensate, they have failed to create approval processes that are transparent and have meaningful deadlines.

Blue Origin's human-centric vision of space will require clarity as we pursue initial capabilities in LEO and on the Moon. We urge Congress to define the authorization framework for in-space activities and ensure that every effort is taken to eliminate duplicative requirements, limit unstructured interagency processes, and draw clear boundaries between agencies with related authorities. Any in-space activity authorization regime should have a single government owner and include the following three key aspects:

- 1) **Strict Timelines.** An activity should be automatically authorized within 180 days unless a specific procedural, regulatory, treaty or national security prohibition is found. This provides a permissive system for innovation and can be scaled more readily than overly restrictive or prescriptive requirements. Where a proposed activity requires inter-agency review to ascertain impacts or overlaps with the regulating authority of another agency, these dependencies should be identified to the operator within a short interim deadline.
- 2) **Self-certification.** Mission authorization should be granted for categories of potential activities rather than specific instances, where appropriate. Non-governmental entities would file an outline of their proposed activities and the authorization under which they fall, not unlike a flight plan. Each operator would be responsible for updating this register as needed to satisfy continuing supervision requirements.
- 3) **Transparency.** Maintaining transparency to the authorization process is important for commercial service providers to build confidence in an industry that necessitates long lead planning. Clear and expedient deadlines should be implemented so that non-governmental entities are not caught in regulatory limbo indefinitely. Active communication paths between operators and the authorizing agency should be encouraged during a review period as each new proposed activity will present a unique challenge.

RESOURCE AGENCIES WITH AUTHORITY IN SPACE

A competitive and innovative regulatory framework for commercial space activities will need resources that support scaling with the industry. We encourage Congress to provide appropriate funding to agencies with authorities in-space. Congress and the FAA helped accelerate the development of the commercial space launch industry, and now the FAA is struggling to scale with the cadence of operation. Streamlining regulations and administrative processes and exploring the possibility for increased training opportunities will help utilize resources more efficiently, but more funding is required to get the right people and process in place. Similarly, as mission authorization requirements are clarified, Congress should ensure that resources match the scope of activities.

Thank you again for the opportunity to testify before the committee today. The United States is a global leader in human spaceflight. Blue Origin is proud to be a part of this legacy.

Senator SINEMA. Thank you so much, Mr. Joyce. I am now going to recognize myself for a first round of questions. It took 16 years to launch the first commercial human spaceflight after the commercial learning period came into effect in 2005.

There have been just 64 total private astronauts sent to space between three total companies, with most of those occurring in the last couple of years. A lack of flight data and widely diverse operations have made it difficult to find consensus on workable industry wide passenger safety standards during the learning period.

Ms. Bandla, you highlight in your testimony that Virgin Galactic's Mesa manufacturing complex is intended to accelerate progress from conceptual design to production to final assembly in order to reach a target of 400 flights per year. I am not sure that the industry can reach this kind of scalability fast enough if we just extend the learning period without thinking through changes.

So, in your view, how should Congress best extend the learning period while ensuring sufficient collaboration between the FAA, industry, and other stakeholders so the FAA is prepared to holistically regulate human spaceflight safely? And what do you believe to be a proper timetable?

Ms. BANDLA. Madam Chair, thank you for the question, and you are absolutely right. The intent of the learning period was to allow commercial companies to look at space flight in a way that does not have bounds on prescribed regulation.

So, they had the ability to develop, to test new capabilities, new innovations, collect data, create a knowledge base of lessons learned to inform a future safety framework. And again, you are correct, it did—it took us a longer time than envisioned in that original bill because commercial spaceflight companies do hold safety above all and are cautious in proceeding forward because we are carrying humans.

But we are at an inflection point. The companies here on the panel have entered commercial operations for human spaceflight and are starting to fly for commercial purposes and at that regular cadence that we all envision. So, it is now the time to have those discussions.

And I completely agree, we should not be moving the goalposts just to move the goalposts. But now is the time, because we have data, we have operators, to discuss what that framework looks like. That is the important part.

The learning period should not lapse without having a blueprint for what a safety framework looks like for human spaceflight so that we can look at what areas need to be regulated, what are the consequences of that, making sure it is still light touch to allow innovation, and also importantly, that the FAA is resourced with the funds and the expertise to carry out that framework.

So, I completely agree. We shouldn't just extend. And there is ways to rather extend, but to transition the industry without a lapse of the learning period. We take this time to get industry and Government stakeholders together to look at what that blueprint is, and that could include milestones such as looking at safety standards, how safety standards are working, what area of safety standards are being developed in industry, and how we can transfer that to a blueprint that, again, I must state, needs to be in

place before the learning period lapses. And in terms of timeline, this is going to take a few years.

While we are entering commercial operations, Galactic has flown nine times, and we still—I still believe that there should be more flights to collect data. So about 8 years is our timeline for, ideal timeline for having these discussions.

Senator SINEMA. And do our other industry representatives have anything to add here before I move on to the next question?

Mr. GERSTENMAIER. I think to your point, one thing we are working with AST on right now is we are in a—committee thing where the industry gets together and we work together as a team, and we are going to make some recommendations to AST for what those regulations might look like.

So, I think it is inappropriate to say we are not working forward on those regulations right now. We are actively starting to work those together as an industry team and making recommendations.

I think the first step we are doing is we are trying to understand what is the benefit of regulations, why are we doing regulations? Are they to help the industry? Are they to fill in a safety hole gap? What is the purpose of the regulations?

And then once we understand that purpose for the regulations, then I can think we can start to build some consensus about what those regulations should be. So, I think it is important to recognize that we are already actively working that, and it is appropriate to extend this learning period for a significant period of time while we have these discussions amongst ourselves, and we can make coherent and complete recommendations back to the FAA.

Mr. JOYCE. Yes. Just one point I would like to add. It is a great question. You pointed out that we just started flying commercial astronauts just a couple of years ago.

So, we are still learning. So, the learning period is appropriate. And extending the learning period for the kind of time that we are talking about here is not only going to allow us to develop experience through operations and improve our safety systems. It is also going to allow new entrants into this industry.

We don't want to shut the door behind us because the lead we have is remarkable and we need to continue that going forward.

Senator SINEMA. Thank you. I now recognize Senator Schmitt for his first set of questions.

Senator SCHMITT. Thank you, Madam Chair. Mr. Gerstenmaier, Mr. Joyce, this is for you two primarily. An example of I think some really intriguing—a development here in potentially critical technology is nuclear propulsion. Talked a little about—this a little bit yesterday. You both talk about how important sustained testing is to the organization of—and further development of your vehicles.

Can you all talk about how just a one-day delay in the mission, or the result of a delayed FAA license can set back, you know, missions for months, right. I mean, how does that work for you? And I think, I guess the second part of that, and I will just ask and let you guys go.

As you look to potentially integrate nuclear propulsion into Starship, or New Glenn, or future vehicles, can you talk about how the delays in that, you know, the launch or testing of these vehicles

jeopardizes future integration of technologies, like I mentioned, nuclear propulsion in getting us to Mars specifically?

Mr. GERSTENMAIER. First of all, I would say that, you know, our approach to the way we do development is we have a very aggressive test program where there is no humans on the spacecraft, and we test the spacecraft in an environment to understand how it actually flies and operates.

We also do that consistent protecting the public. We want to make sure that no one gets hurt. Nothing is damaged except maybe our own facilities. But we use that as a series of test flights. With that approach, it is important we fly as soon as we can—the hardware is really ready to go fly.

When we have regulatory delays, such as we are facing right now, that slows down this developmental test flight and ultimately slows down our support to NASA and slows down our support to what we need to do for the—to return humans back to the surface of the moon again.

So, it is critically important that these delays may seem small in the big scheme of things, but a delay—continuous delay of each and every test flight just adds up and eventually we will lose our lead and we will see China land on the moon before we do. And it would be a shame if we did that only because of regulatory burden and we didn't do it because we were not technically ready to go achieve and innovate.

So, I think it is absolutely critical we get a regulatory framework that allows us to fly at the fastest flight rate that we can fly on and fly still safely—protect the public and protect people on board. In terms of nuclear propulsion, I think that is a very interesting technology that is coming online. I think research from other agencies like NASA and other organizations are appropriate to go look at that.

When that technology kind of gets developed by some of the other Government agencies, then we on the private sector can pull that in and start using that in our operational vehicles.

But I think our focus right now is trying to push the capability to bring this next generation of heavy lift launch vehicles in place, Starship, that can support multiple destinations to the moon and ultimately to Mars and help us have this vision of moving human presence into the solar system.

Mr. JOYCE. I guess what I will add—that nuclear propulsion is a game changer for in-space operations. It is an incredibly attractive technology. It obviously needs careful consideration for safety considerations. We think it is important that—you asked the question about delays in launch.

And so, for commercial endeavors where private investment is being brought to bear, significant private investment, delays in the process are very expensive. We want to enable industry to move as quickly as possible in a safe way, working with the Government agencies that are appropriate, an interagency process, because really it all starts with launch.

And getting through those regulations and streamlining these processes is important for this kind of a game changer technology going forward.

Senator SCHMITT. And as both of you notice, as a followup, we discussed yesterday sort of, you know, on this committee and then also on the Armed Services committee, and both your companies contract with DOD and support vital national security efforts.

Can you talk a little bit about the balance between truly national security missions and truly commercial missions and why it is important that one not limit the other?

Mr. JOYCE. Well, at Blue Origin, and I think my colleague here will say the same thing, that a lot of the commercial activity enables the defense activity and vice versa.

Private investment, significant private investment in commercial human spaceflight at Blue Origin is enabling technologies that are being applied to our DOD contracts. Specifically, the technologies that I work on New Shepard are being utilized on the New Glenn heavy launch vehicle that is the launch vehicle that the Space Force is looking at and we are excited to hopefully participate in that program going forward.

These investments, these technologies, processes, and people provide a coupling between the two and provide a more rapid delivery of capability to the Space Force in particular.

Mr. GERSTENMAIER. And I would totally agree that they are very synergistic to commercial, and your national security activities really feed off of each other.

Starship, which we are doing for commercial activities predominantly, will have tremendous benefit to the national security space side. We will have a new capability to launch extremely large satellites to low-Earth orbit and also sponsor missions around the moon and other areas.

So again, there is a natural synergy between the two. Even Starlink that we are using for commercial Internet services has applications in the secure—national security domain. So, there is a very strong synergy between that.

To be a leader and technology allows you to be a leader in the commercial activities, but also in national security activities.

Senator SCHMITT. Thank you. Thank you, Madam Chair.

Senator SINEMA. Thank you. Senator Cruz is the Ranking Member of the full Commerce subcommittee, and he is now recognized for his opening statements. Thanks so much, Senator Cruz.

**STATEMENT OF HON. TED CRUZ,
U.S. SENATOR FROM TEXAS**

Senator CRUZ. Thank you, Madam Chair, Ranking Member Schmitt. Thank you both for the terrific job you are doing with this very important subcommittee. And welcome to each of the witnesses.

Since I was first elected to the Senate 11 years ago, I have been proud to help lead nearly every major piece of space legislation that has been signed into law. Just last year as part of my NASA Authorization Act, which I led alongside Senator Sinema, Senator Wicker, and Senator Cantwell.

That legislation was included in the CHIPS and Sciences Act, securing, among other things, an extension of the International Space Station to 2030. I am especially proud that Texas is at the forefront of American leadership in space, from NASA's Johnson Space Cen-

ter in Houston, home to our astronaut corps and mission control, to the myriad of commercial space companies across the State, including SpaceX and Blue Origin, who are both here today. The road to the final frontier runs through Texas.

But we can't rest on our laurels. As the pace of commercial space activity has picked up, our regulatory system has started to strain and is now showing serious cracks. Some of our witnesses have hit on this point today.

But it is worth noting that if the system breaks and the commercial space industry grinds to a halt, the risk is far more substantial than a few billionaires losing their ability to take joyrides in space.

The Government relies on a vibrant domestic commercial space sector for access to space, whether that is transporting our astronauts to the ISS, sending rovers to Mars, launching national security missions, or any of the other myriad space missions.

On most policy issues, my philosophy is quite clear, get Government out of the way to the greatest extent possible and let the private sector roar. I believe the commercial space sector holds tremendous potential and I have long said that I think the first trillionaire will be made in space.

Previously a domain exclusively of Governments, upstart commercial companies have helped democratize space in a way that very few thought possible even a decade ago. Along the way, they have helped drive down the price point of launch, which has helped save the taxpayer money, and has led to a proliferation of new technologies and plans for in-space activities.

But to accommodate this growth and to enable the future potential, the regulatory framework must be clearly defined, allow for innovation and be accountable for the actions it does or does not take.

As we think about regulation and commercial space, top of mind for many is the expiration of the learning period. This is understandable and an issue we need to, and I believe will address. But we need to answer the broader and more definitional questions about what the future of regulation looks like, not just for the next 2 years, but for the next 20.

The prior Administration did good work to try to update and modernize launch and reentry regulations, but there is a lot of work still to be done. Similarly, we need to address the still burdensome remote sensing regulations, and we need to cut red tape around all the various types of permitting that permeate commercial space.

This hearing today is an opportunity to learn from those in industry, and the academy, and from a former policymaker about the state of commercial space, and to reflect on how the current regulatory scheme is or is not working.

In my opinion, too many agencies are involved. It slows technological and scientific advancements, and it puts us at a disadvantage compared to our international competitors and rivals. It is long past time that we create a true one stop shop for the regulation and licensing of commercial space activities and make the United States the destination of choice for commercial space companies looking to set up shop.

That all starts with regulatory certainty, transparency, and accountability. Finally, I mentioned the ISS. It is imperative that the United States maintain a human presence in low-Earth orbit. With ISS's mission extended until 2030, it is important to talk about what is next.

Not only is LEO the tip of the spear on commercialization of space, but more fundamentally it is a strategic domain where we cannot afford to cede our leadership, especially to communist China.

I look forward to hearing from our witnesses today and to continuing to work with Chairwoman Cantwell, subcommittee Chairwoman Sinema, Ranking Member Schmitt, as we together craft a bipartisan, bold, and forward looking commercial space bill. Thank you.

Senator SINEMA. Senator Cruz, you are recognized for your questions, if you would like to.

Senator CRUZ. Thank you, Madam Chair. Mr. Gerstenmaier, welcome. Thank you for being here today. Thank you for your many years of service with NASA.

I think I can speak for many members of this committee when I say that we were all watching with excitement as Starship made its first test flight at Boca Chica earlier this year, and we look forward to you all proceeding with your next launch and more as you get ready to help put American boots back on the lunar surface.

I also greatly appreciated the opportunity recently to visit Starbase in Boca Chica, Texas, over the August recess to see firsthand the incredible work that SpaceX is doing in South Texas. And I don't want to exclude Mr. Joyce here. Van Horn is on my list, and I am planning to get out and see the great work Blue is doing in West Texas as well.

Look, the commercial space industry is at an inflection point. Industry, with some Government support, but also leveraging immense amounts of private capital has brought new novel technologies into production that hold the potential to do everything from closing the digital divide in broadband Internet to making the human race truly multiplanetary.

They are ready for—to take off, if only we will let them. And Mr. Gerstenmaier, you have extensive experience with space vehicle development and space operations.

I want to ask you what may seem like a simplistic question, but it gets at something you raised in your testimony. In your experience, and obviously there are caveats, are flight proven vehicles and hardware more or less reliable than vehicles and hardware that aren't flight proven?

Mr. GERSTENMAIER. I think there is a tremendous advantage of a flight proven vehicle. You see that in the reusability of the Falcon program. You know, we have flown 74 flights this year. We learn from every one of those flights.

And that learning, if we are open and transparent and we see where problems are, we can fix those small problems before they become big problems. So sometimes it is seen as we are rushing to flight, but we are actually by flight testing—we are effectively flight testing the vehicle every time we fly, and we are learning, and we are developing. We are doing the same thing with Starship.

Starship's test flight may to some have looked like a failure. It was not a failure. It was a huge learning experience for us. We gained more data from that flight, more knowledge that helps us advance than we could have through a thousand years of an analysis and mathematical studies and tests.

Going to flight, still protecting the public, keeping the environment safe allows us to move at the fastest pace we can. So, I am a strong supporter of active flight test.

Senator CRUZ. Well, thank you. I very much agree, and I think that is objectively correct. But to pull on this thread, articles in The Washington Post and Ars Technica yesterday discussed how SpaceX has been ready for its second Starship launch for weeks but is now apparently waiting on the Fish and Wildlife Service, who, just to be crystal clear, they don't launch rockets, but Fish and Wildlife needs to finish its consultation next month.

I can't help but be concerned that bureaucratic red tape at AST and Fish and Wildlife, and from other agencies, have injected themselves into the launch licensing process. All of these agencies have already conducted and approved an environmental review for the first launch of Starship.

But since SpaceX is going to keep trying, now the Federal Government wants to do another entirely duplicative environmental review. Do you think other agencies' involvement is speeding up or slowing down SpaceX's ability to test, launch, and iterate vehicle development?

Mr. GERSTENMAIER. I mean, as we are—it is a shame when our hardware is ready to fly, and we are not able to go fly because of regulations or re-review. The fact that we can get the launch pad repaired and get it ready to go fly, support of flight.

The fact that I can get a vehicle manufactured and ready to go fly. We have three or four other vehicles also ready to go fly. The pace of our test flight should not be governed by the regulation.

We need to be safe. We need to protect the environment. We don't dismiss those, but we need to fly at the fastest pace that we can do hardware development to do this active development process and this test flight experience that we described.

Senator CRUZ. Well, again, I agree with that. At AST's current speed, what is the earliest HLS will be ready?

Mr. GERSTENMAIER. It is hard to say. We have got to, you know, the—we need to fly at the fastest pace. To be fair, we also have huge technical challenges, right. This is a large spacecraft we are building. You got to see it when you went down to Boca. It is an amazing vehicle.

But 33 engines, the staging, all this is new technology. We need to test that soon, learn what is wrong, fix it, and go fly again. And we cannot be held up by regulation. So, it is hard for me to give a specific date of where we are. But the current pace where regulation is driving, that should not be the case.

The burden should be put on us as a private company, put it on SpaceX, and let us develop at the fastest pace. We should be the ones that are driving the development, not being driven by regulatory oversight.

Senator CRUZ. And having seen firsthand what you are doing in South Texas, it is extraordinary and very, very impressive. My

final question, if you were still at NASA, would this delay be acceptable? Would schedule delays like this be something that makes a NASA program successful?

Mr. GERSTENMAIER. Simply, it would not be acceptable.

Senator CRUZ. Thank you.

Senator SINEMA. Thank you, Senator Cruz. Senator Peters.

**STATEMENT OF HON. GARY PETERS,
U.S. SENATOR FROM MICHIGAN**

Senator PETERS. Well, thank you, Madam Chair, and welcome to each of our witnesses. Happy to have you here and thanks for helping us better understand the opportunities as well as the challenges for this industry.

I want to take my time for at least my first question and talk a little bit about a key aspect to a successful commercial space industry, and that is having a domestic supply chain that is vibrant and resilient. I am proud that Michigan is a top 10 State in aerospace manufacturing.

We have over 600 aerospace related companies, and I am very proud to say we are continuing to grow at a very robust rate. I have heard it in some of your testimony here today, and certainly I have heard from my former colleague Bill Nelson, who is now the NASA Administrator, who I think is a dream job for him given his passion, that we are basically in a space race with China.

And I think all of you will agree. And certainly, if we are in that race, we need to support a robust domestic supply chain to win that race. And that is why I authored two bills about domestic aerospace supply chains that were actually signed into law last Congress through the CHIPS and Science Act.

But my question for you, Mr. Maier and Mr. Joyce, and anybody else who would like to join in, if give me—if you would like to comment basically on what your companies are doing to ensure that you are indeed relying on a strong domestic supply chain for commercial space activities.

And also, if you could address if there are any bottlenecks in the supply chain that we should be aware of and perhaps could be helpful in addressing. Mr. Joyce, if you want to start, and Mr. Gerstenmaier.

Mr. JOYCE. Yes. Thank you, Senator, for that question. Blue Origin is heavily dependent on a robust supply chain for all of our operations, New Shepard, New Glenn, and our in-space systems. We have multiple partnerships with companies around the United States that are supporting us, including in your State, Senator.

So, the robustness of the supply chain, particularly coming out of the pandemic when we are all challenged to meet our commitments and to support our development schedules with a supply chain that was struggling, kind of highlighted our need to better engage and to go deeper with that supply chain.

That is what we are doing today at Blue Origin, developing long term partnerships, long term agreements with a number of ours. We are also partnering with local manufacturing companies in all the States where we operate.

So, it lifts the entire industry beyond the direct expenditures at Blue and the people that we employ, to hundreds or thousands of people throughout the country throughout our supply base.

Senator PETERS. And that supply chain, how much of that is domestic?

Mr. JOYCE. Almost all of it, sir. There are very few things that we have to go overseas for, and we are focused first on domestic supply.

Senator PETERS. Right. Great. Mr. Gerstenmaier.

Mr. GERSTENMAIER. And I would say that, you know, this year we are going to attempt to fly 100 flights. We have a very strong dependence upon the supply chain for a lot of parts that we put together and assemble into parts for our vehicles.

As we look to next year, we want to increase that flight rate to about 12 flights per month, or 144 flights is our goal. We have already reached out now where we are offering multiyear contracts to suppliers to provide us hardware. We are also pushing some of the reliability aspects to the suppliers.

Where we used to do inspections when the hardware came in-house, we are now pushing that inspection back to the suppliers. So, they are becoming more of an active participant with us moving forward. So, the supply chain is critical to us as we move forward and try to achieve these higher flight rates.

Senator PETERS. So, I guess the second question—sorry, I didn't hear. Are there any bottlenecks out there that we—certainly, we identified a lot of those after the pandemic. You have been working through those. Are there other things that you are concerned about that we should be aware of?

Mr. GERSTENMAIER. I think for us it has been just to keep up with the rate of demand we have for the parts and pieces. And I think before we didn't order in a larger quantity as we are now, and we think we are—that is going to help remove some of that bottleneck. If we let the suppliers know what the anticipated demand is, they can then spool up and get ready to supply at the higher rates.

Senator PETERS. Right. Thank you. Mr. Joyce.

Mr. JOYCE. Yes, I don't think I would point to a single or even a few supply chain issues that really drive us. There traditionally have been things that we have scrambled and recovered from. But we can take that question and get you an answer—

Senator PETERS. Yes, I would appreciate it.

Mr. JOYCE.—with some detail.

Senator PETERS. Thank you. Anybody else have anything? If not, thank you. Thank you, Madam Chair. Thank you.

Senator SINEMA. Thank you, Senator Peters. Senator Hickenlooper.

**STATEMENT OF HON. JOHN HICKENLOOPER,
U.S. SENATOR FROM COLORADO**

Senator HICKENLOOPER. Thank you, Madam Chair. And thank all of you for kindly giving us your time today and for all your work in terms of promoting space, and the incredible acceleration we have seen in our aerospace industry in the country and in the world.

Ms. Schenewerk, I will start—I have a question for each of you, so if I don't—hopefully keep your answers short, and I will get as far as I can. As our Nation's aerospace economy continues to grow, the private sector—we have heard all through this hearing, the private sector needs clear and predictable rules to govern outer space activities. Colorado obviously also has a strong aerospace component.

A lot of companies working on everything from new commercial space stations that can host research and tourism in space, to technologies that will remove orbital debris or manufacture parts in space.

These new activities do not fall under any singular agency's regulatory purview. Ms. Schenewerk, what lessons should Congress learn from the most recent regulatory reform efforts in terms of developing the mission authorization framework?

Ms. SCHENEWERK. So, first and foremost, Senator Hickenlooper, I will start by commending you and your staff because you are doing exactly what I would recommend, which is engaging with industry.

So, I think that the effort to engage with industry is really important. And what—on some of the other topics that we have addressed today, like the regulation of launch, the oversight of nuclear thermal propulsion, for example, there is a need to have that deep engagement with industry in order to make sure that we are tailoring legislation and then the regulations to follow so that they can be flexible and appropriate to the core aspect of what we are trying to address, which generally speaking is public safety or a national security need.

So how do we define what we are trying to address, make sure that we are getting to that core root concern, and then tailoring the legislation in a timely manner to that issue. And making sure that as we move forward, we are not overreaching, or thinking about what we are doing today, making sure we can pressure test against that, and then prepare for a future state where we can address future opportunities.

Senator HICKENLOOPER. Great. Thank you. Mr. Gerstenmaier, this is something I have been talking about for a couple of years. There are over 900,000 pieces of dangerous orbital debris traveling faster than the speed of a bullet hurtling through space right now.

It not only threatens the International Space Station, but it threatens our human exploration programs, commercial space activities, satellite constellations, go down the list of. So, Mr. Gerstenmaier, what are the consequences for a commercial in-space activities if we don't quickly mature our capabilities to be able to track down and remove dangerous debris objects?

Mr. GERSTENMAIER. I think it is important that we recognize that the debris environment is there. We design our spacecraft to be protective of that to some extent for the smaller particles.

For the larger objects, for example, on Starlink, we have automatic collision avoidance in the satellites themselves, so they actually maneuver on their own based on data to avoid collisions with other aspects.

And that is another advance, I think, that can help prevent generation of debris. But I think we need to recognize that debris environment is there.

I think it is just naturally there in some extent, and we can protect for it as much as we can through spacecraft design. But also make sure that the systems we deploy in space limit the amount of debris that are generated as we deploy other spacecraft.

Senator HICKENLOOPER. Well, certainly debris is naturally there, but it is growing at a—you know, it threatens exponential growth if we are not careful. Ms. Bandla, as in-space activities and new spacecraft enter orbit, so does congestion in LEO.

And again, I think the activity and the acceleration of activity is a good thing for our leadership in space. The Government Accountability Office and other agencies have noted though, these activities also increase collision risks.

It is not just the increase in objects that are out there, but it is the traffic and in many cases pose potential impacts to astronomy. How should the U.S. balance maintaining our leadership in space with our obligations to making sure that we are maintaining a safe and operable space environment?

Ms. BANDLA. Thank you, Senator, for the question. So, Virgin Galactic is a purely suborbital operations, but I think you touch on a very important point.

When we talk about regulations that don't hinder innovation and allow for companies to innovate and create new capabilities, that is also for creating capabilities, not just technologies that are, excuse the pun, out of this world, but creating capabilities that enhance safety and efficient operations.

If I can just make a quick example in the aviation world, actually. Experimental aircraft were way ahead in avionics systems than certified aircraft and they were able to—and certified aviation companies were not able to adapt because going back and taking the time and resources for changing the certification did not provide them incentive and allowed them to say this was safe enough.

So, regulations that are light touch, that promote innovation, but do not hinder say—that keep safety as priority, also enhance safety as an efficient operations for the entire industry as well.

Senator HICKENLOOPER. Yes, that is something we have heard consistently from all of you, that this priority is—safety in space, and I think we are hearing that loud and clear. I yield back to the Chair.

The CHAIR. Thank you. Senator Luján.

Senator LUJÁN. I yield to the Chair of the Committee—

The CHAIR. No, no. Senator Luján, please.

**STATEMENT OF HON. BEN RAY LUJÁN,
U.S. SENATOR FROM NEW MEXICO**

Senator LUJÁN. Thank you, Madam Chair. I appreciate that very much. Ms. Bandla, it is good to see you today, and my first question is directed toward you and your expertise. I think all of the companies here today agree that the commercial space industry is poised for explosive growth.

That is clearly a consensus here in the U.S. Senate as well, but specifically at the spaceport in New Mexico. And so those of you

looking to grow a little bit, come visit New Mexico. We have a space for you, so come on down.

Now, the FAA's Office of Commercial Space Transportation has maintained an outstanding record of protecting public safety according to their statutory mandate. But as the cadence of launches and number of applications continue to grow, the Office of Commercial Space Transportation, also known as AST, face challenges with its workforce and licensing capacity.

So here is the question, are there ways that Congress can help AST keep up with the growing number of license applications while maintaining its excellent public safety record?

Ms. BANDLA. Thank you, Senator. And it has been such a great year. We have flown five times in 5 months from Spaceport America.

The State has been an incredible partner in being able to hit that cadence of operations, and of course, our partnership with the FAA as well enabled that. Absolutely, it is natural. As the industry grows, we are at this inflection point where you are seeing a higher cadence of flight, more frequent flights, diverse vehicles. It is natural to also have the regulatory agency grow as well and be provided with the adequate amount of resources and expertise to keep up with that pace.

And these resources will allow FAA to process licenses, allow companies to operate at this cadence, and especially take a look at their licensing process now and look at ways to make it more efficient and more effective.

Not just add bodies, but look at the licensing portal, how we can make it electronic, how companies can track their licenses and status in a much more efficient way to relieve that stress on the actual bodies at the agency as well.

So, there is a lot of conversations we can have on how we make that agency more effective in licensing, but it starts with giving them the adequate resources to be able to do so.

Senator LUJÁN. I appreciate that, Ms. Bandla. Just as a reminder, it doesn't get too hot, it doesn't get too cold, and once you climb above the hot air balloons, you are good to go. And the food is pretty good, so come on down.

Now, Ms. Schenewerk, the FAA has restricted—or was restricted from enforcing regulations specific to safeguarding the well-being of paying and nonpaying customers or occupants aboard commercial space launches and reentries to allow emerging spaceflight companies to gather experience, data, statistics, and other information.

Since this learning period began, emerging commercial space flights have provided—have proceeded at a cautious pace. Given that as the commercial human spaceflight industry works up to full scale regulation, how can Congress help the FAA and commercial spaceflight industry leaders begin to work together to compare their initial data and statistics to share lessons learned, to outline a regulatory plan that addresses the safety of paying and not paying customers, and other occupants aboard commercial spaceflight?

Ms. SCHENEWERK. Senator, thank you for the opportunity to comment on this. So, I think first and foremost is that no people get to space without having the launch vehicle license.

So I really want to reiterate the points that my colleagues have made today about the importance of making sure that the FAA's launch and reentry regulations that govern launch, whether it is a satellite for national security, civil commercial space, or it is a human spaceflight participant, that that launch licensing regime and reentry regime needs to be improved and the resources that need to go into that for training, the implementation of better processes, all of that will benefit any activity that involves human spaceflight.

So, I think first and foremost, those improvements need to occur. The second is an aspect that is ongoing and that is the engagement through the Space Advisory Rulemaking Committee, specifically on Part 460 right now, which addresses the regulations that are existing now, because despite a lot of thought to the contrary, the contrary is true, which is there are regulations addressing both the crew, so the humans that are on board that are involved in flying or even off the ship that are flying the space vessel, as well as the spaceflight participants.

So, there are regulations and those are part of discussion with industry through an FAA advisory rulemaking committee today. I also want to highlight the work of COMSTAC. So, the Commercial Space Transportation Advisory Committee, which is a FACA that advises the FAA.

That is an important organization, an entity that can provide inputs and review of FAA documents and plans. And I will note that recently the FAA released a document on occupant safety. Unfortunately, the COMSTAC wasn't able to review and opine on that document ahead of its release. And I think that the document and the engagement with the FAA and the outcome would have benefited from that industry engagement.

So, we think there are a number of steps. Also, ASTMs, the work that is happening with standard writing with industry. That pace has increased as we have seen a pace of human spaceflight and experience increase.

All that said, to my colleagues' prior points, very few flights are happening right now in terms of the numbers. We have the opportunity to start getting it right, to start establishing a plan, and that plan really calls upon true engagement between the experts in industry who are developing this diverse set of capabilities, and the folks within the regulatory agency that need to get smart and need to deeply engage with those activities.

But first, they need to get good at doing the regulations that they have on the books today.

Senator LUJÁN. I appreciate that. And Mr. Joyce, I have a question I am going to have to submit into the record because I have exceeded my time. But I want to commend your team over at Blue Origin.

I had the honor to visit facilities in Washington State recently, and it is quite incredible what is been built there, the expertise of that team as well, but quite an impressive facility. So, I look forward to visiting more about that and getting those questions submitted. Madam Chair, I yield back.

Mr. JOYCE. Thank you, Senator.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

The CHAIR. Thank you, Senator Luján. And I want to thank Senator Sinema and Schmitt for holding this Subcommittee hearing and all of you for participating today. Thank you so much.

I appreciate all my colleagues obviously being here and asking important questions. We have reached new heights, including the striking images of new galaxies from the James Webb telescope.

The U.S. space program continues to evolve and forge ahead with partnerships between the public and the private sector. SpaceX's Falcon 9 was the first to take the NASA astronauts to the International Space Station, and now civilians are riding on the edge of space in commercial aircraft.

So, we are very excited about all of this in the State of Washington. We like to say that Seattle is the Silicon Valley of space. That is the intersection of software and hardware and probably Boeing engines and other things all coming together.

And I think we have something like \$4.6 billion in economic activity and 13,000 jobs. So, we had the NASA Administrator out this past summer to talk about some of that innovation and a little sharper focus on workforce issues, very concerned about workforce needs at FAA, at NASA, in the space sector in general, and what we need to do to further incent or encourage young people and people of diversity, particularly women, to go into that field.

And certainly wanted to continue the R&D, innovation, and collaboration, but really start thinking about what one might consider a high rate piece part manufacturing juxtaposed to where we have been thus far.

So, how do you speed up the next level of aviation, aerospace construction and what do we need to do to be really good at that. So, those were some of the conversations we had in Seattle with the Administrator and a great group of participants from a variety of segments. And I wanted to follow up today first with that question about STEM and workforce.

Very excited that NASA continues to play a very big role for the FAA, and we are really with the FAA safety bill that we passed a couple of years ago, trying to increase the technical expertise at the FAA in next generation technology issues.

What do we need to do to get this right at NASA and in the private sector in encouraging a very, very robust space workforce? And just go right down the panel.

Ms. SCHENEWERK. So, I think you are right to focus that there is a need within the FAA to make sure that we are able to attract and retain excellent talent there.

So, you know, some ideas have been put forward about the idea of expediting hiring opportunities. I also think collaboration between industry and Government with regard to employees.

So, we have employees that go from one agency to another agency, but in some instances there are opportunities, for example, with this former Air Force, Space Force, there were embeds from Government with industry, and that really does foster a technical interchange and understanding, and that also can help understand the opportunities that are in Government to stay in Government.

So, you know, for example, I will commend my colleague here, Mr. Monteith, who left the Air Force then, and then went into Government service again to work with the space industry at the—at AST, and those kinds of exchange of impressions, even from Government agency to Government agency, but particularly where we can foster from industry movement and exchange there.

The CHAIR. OK. We will have to go more quickly on answers down the panel.

Mr. MONTEITH. Thank you, Chair Cantwell. I would simply put it in two buckets. Number one, I think we have—need to have a much more robust intern program to get them—the college grads or future college grads interested early into Government service and there is technical fields.

And number two, tagging on to Ms. Schenewerk's comments, when I was in FAA, we had started looking at how do we move back and forth, not from Government agency to Government agency, but from Government agency to industry and back, because I think the entire system would be better served from having more technically knowledgeable and advanced employees on both sides.

The CHAIR. OK.

Mr. MONTEITH. Thank you.

Ms. BANDLA. I completely agree with both my colleagues. I just—talk about the underrepresented group. Look at programs that invest in demographics that don't—you don't typically see in industry, women, people of color. They don't have the same opportunities as others.

So, programs that do reach that group. And it is interesting because I am a woman, person of color. I joined this industry and believed I could succeed in this industry because I met people from this industry doing incredible things and that made it real and made it a possibility.

So, let's look at programs that reach out to those communities that don't have those opportunities.

Mr. GERSTENMAIER. You know, I would add that if there is an exciting mission, that people can get really excited about it, and they can see a sense of the future that is brighter, and a chance to really open their horizons. Space gives you that opportunity to think about a better future.

And I think we can entice the young people to get excited about that. And then if we can also be open to new technology. If we can take what they have learned in gaming, what they have learned in computer world, and bring that into our world, we can expedite manufacturing. And I think we also need to be extremely open in the diverse areas.

We need to be open to all ideas and not assume that anyone doesn't have an idea that has value and cannot be used. We need to be open to every idea. Look for innovation. And the same thing even with a regulatory environment.

We can no longer continue the same process. We need to look for ways to be innovative and creative, and open the aperture so we can accept diverse opinions and different ways of doing business. We keep doing things the same way, we won't get the results we want. But I think that excites the young generation.

The CHAIR. Thank you. Mr. Joyce.

Mr. JOYCE. Yes, I think the only thing I would add, and my colleagues have made some of these points, is play the long game, expand the workforce, right. How do you do that?

You get more women, more people of color engaged, and you start that at an incredibly early age to make it more attractive, more appealing to those groups to join the type of workforce that we need in this industry and the FAA needs to regulate. Make the pool bigger. Start early.

Blue is sponsoring a Club for the Future, which is a STEM program. It starts in preschool. It starts in elementary school. I think we need more of that to encourage—

The CHAIR. It starts in preschool?

Mr. JOYCE. It starts in kindergarten, actually.

The CHAIR. OK.

Mr. JOYCE. We have a number of—close enough. So, but yes, but why not, right. It is one of those things where you want that culture. You want these people to grow with that opportunity, to see people, like my colleague, Ms. Bandla here, doing what she is doing and be able to do that themselves. So, I think that is how we do it.

The CHAIR. Yes. Definitely as an application of STEM occupation, I don't think you can get something more exciting or more interesting, so we would hope.

But I do think we—as I have traveled to various facilities around the country, it is clear to me that there are a lot of technical people at our space facilities. They don't have 4 year degrees.

And we need to send out a big, loud message everywhere that these are technical jobs that are well-paying jobs, but that we need to—I don't know if there is this—if we are missing a space at the community college where we are saying this is your space technician program or something like that, but I feel like we should be doing more in this particular area.

As I said, my region, very interested in this as we transfer more to large scale—I mean, more rapid pace manufacturing and production. And then I am going to send for the record, Madam Chair, this question, you know, which today's hearing isn't squarely on, but—well, I just want to make one more point about this.

I literally believe that we have to start thinking about CTOs, and maybe even CTOs by sector. By that, I mean, if you think about it, you know, within the FAA, there may be a CTO specific to certification and there may be a CTO specific to commercial space.

I just think the changes in technology are so rapid that you need somebody who is the overall guidance when it comes to the types of innovations we are seeing. How else do we keep a whole workforce at the FAA up to speed on that?

I ran into a gentleman in my community, Edmonds, Washington, but that is where you will run into a lot of Boeing engineers just walking around on a Saturday afternoon. But he said, you know, we used to have chief engineers and he said there is never a way to fool the chief engineer. You always were afraid to go in front of them because you knew you were never going to fool them.

And so, the point is that now we have all this technological change, and it is so big. And as the FAA grapples with still certifying commercial airplanes, but then trying to figure out how to

certify space travel, how are we going to do that without some key technology leaders at key posts within the FAA?

OK, so I will submit some questions for the record on that. But I thank the witnesses for this hearing and appreciate the input, particularly on the safety side, but also on how we come back to this issue of the certification that is expiring—the learning period that is expiring and what we need to do for the future. So, thank you.

[The prepared statement of Senator Cantwell follows:]

PREPARED STATEMENT OF HON. MARIA CANTWELL, U.S. SENATOR FROM WASHINGTON

The United States is the world leader in Space Exploration. We were the first to have a pilot-controlled space flight and the first to land a man on the moon.

Today, we continue to reach new heights including the striking images of the formation of new galaxies from the James Webb telescope. The U.S. space program continues to evolve and forge ahead with new partnerships between NASA and private companies.

Space-X's Falcon 9 rocket was the first to take NASA astronauts to the International Space Station as a commercial service. And now civilians are riding to the edge of space on commercial spacecraft.

My home state of Washington has been called the "Silicon Valley of Space." The space industry contributed an estimated \$4.6 billion in economic activity to Washington communities in 2021 and supports over 13,000 jobs.

Notably, our regional businesses are at the forefront of commercial human spaceflight. These workers are helping maintain America's position of leadership in space applications, space science, and space exploration.

However, our leadership position in the future of space operations is not guaranteed.

We face significant challenges in ensuring the safety of commercial spaceflight participants and the public as we increase the frequency and complexity of human space operations.

As we chart a path forward, we need to ensure that our safety regulations are based on sound data and best practices, that they protect the health and well-being of our crew members and spaceflight participants, and that they minimize the risks of orbital debris and collision.

We need to establish clear roles and responsibilities for the Federal agencies involved in regulating various aspects of commercial human space activities.

That is why we need a clear and consistent regulatory framework that balances the interests of all stakeholders and fosters a stable and predictable business environment without compromising safety.

We also need to support the continued innovation and competitiveness of our commercial human space sector and the space industry by investing in research and development, infrastructure and workforce development.

At a Space Summit I had in Seattle in July, experts from academia and industry discussed the urgent need to attract talented workers to fill today's aerospace jobs as well as the in-space jobs of the future, where traditional trades such as mining, construction and facility maintenance will need to be adapted to activities on-orbit and on the surface of the Moon and celestial bodies.

Maintaining our focus on STEM education will enable the United States to leverage the capabilities and expertise of the private sector to achieve our national goals and priorities in space exploration and science, and ensure our economic and national security.

To continue to be a world leader in the aerospace industry we must also be the leader in safety.

I look forward to hearing from our witnesses today on your insights into the current state of the industry, the opportunities and challenges ahead, and how to ensure both safety and competitiveness.

Senator SINEMA. Well, thanks so much, Chair Cantwell. And with that, we have reached the end of today's hearing.

And once again, thank you to all of our witnesses for their participation. The hearing record will remain open for four weeks until November the 15th of 2023.

Any Senators that would like to submit questions for the record should do so within two weeks from now, by November 1, 2023, and I ask that witness responses be returned to the Committee by November 15, 2023.

And that concludes today's hearing.

[Whereupon, at 3:27 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO
CARYN SCHENEWERK

Mission Authorization

Current FAA regulatory authority covers launch and re-entry of crewed and uncrewed spacecraft but does not extend to on-orbit operations with or without humans. Yet the United States Government, under the 1967 Outer Space Treaty, must authorize and supervise these activities conducted by U.S. entities. I am aware that some in the space community believe that we should extend the FAA's licensing authority to cover all human space activities while providing the Department of Commerce with authority over all in-space mission areas and activities that do not involve humans.

Question 1. What do you view as the most effective division of regulatory responsibility between Federal agencies?

Answer. Instead of further division of regulatory responsibility between Federal agencies for space activities, it is important to recognize the importance of consolidating regulatory oversight, avoiding duplication of efforts and inefficient processes. U.S. space companies are increasingly engaging in innovative activities like satellite servicing, private space stations, in-space manufacturing, and lunar rovers. They are not designing their operations, nor should they, to align with burdensome divisions of responsibility among multiple agencies.

The 2020 National Space Policy, along with industry representatives and congressional legislation, have proposed granting the Department of Commerce's Office of Space Commerce (OSC) the authority to approve commercial in-space and in-situ operations. This recommendation acknowledges the Commerce Department's existing role in regulating in-space activities and its focus on fostering a robust U.S. space industry while protecting national security and complying with international treaty obligations. Such an approach aims to provide a minimally burdensome regime for authorizing in-space missions, emphasizing the need for significant accountability, transparency, and clear timeframes.

To some degree, modeling the legislative approach on the Commercial Space Launch Act (CSLA) makes sense—creating a flexible statute that can effectively review near-term capabilities in a timely and efficient manner, with the flexibility to expand authorities as the industry develops. This strategy avoids trying to predict all future technologies and risks, instead opting for a flexible approach that ensures treaty compliance and fosters national security. That said, the text of the CSLA is not my suggested starting point, nor do I think the launch and reentry regulations are appropriate—that bill and those regulations are intended to protect the uninvolved public on Earth. They were not drafted to address in-space activities.

An efficient and effective interagency process involving appropriate consultations will be key to a minimally burdensome regime for authorizing in-space missions in a responsible and timely manner. A well-designed and effectively implemented approach will be able to review a variety of applications for in-space activities and appropriately undertake an analysis of their compliance with international treaty obligations and U.S. interests. I encourage Congress to consider an approach modeled more on the commercial remote sensing regulations and less on the launch and reentry regulations. The remote sensing regulations focus on the core capabilities and technologies that are of concern—they are narrowly scoped and intended to be streamlined. Further, the Department of Commerce is experienced with in-space activities whereas such oversight would significantly expand the already stretched capabilities at the FAA, in addition to vastly expanding their scope beyond those activities that may impact the uninvolved public on Earth.

Congress should take action to grant the Department of Commerce authority to review and adjudicate novel space activities in a manner that complies with our treaty obligations. The kinds of activities currently contemplated offer significant economic, space sustainability, civil and national security benefits, including the

ability to remove debris, refuel or reposition satellites, conduct manufacturing in-orbit and even move industrial activities that are detrimental to Earth into space.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KYRSTEN SINEMA TO
CARYN SCHENEWERK

Mission Authorization

I am excited that Blue Origin has partnered with Arizona State University on the Orbital Reef commercial space station project. This project seems to epitomize “novel” space activities—all the potential applications of a space station with attachable modules cannot possibly be known. The ability for private companies to train non-government astronauts and conduct commercial operations in low Earth orbit is a true game changer.

Of course, under current law there is no defined regulator with such a new “mission authorization” authority.

Question 1. As Congress works to clarify agency authority and remove uncertainty over novel space activities, what are the critical components to create a workable, efficient, and safe regulation?

Answer. The U.S. government should take action to grant the Department of Commerce authority to review and adjudicate novel space activities in a manner that complies with our treaty obligations. The kinds of activities currently contemplated offer significant economic, space sustainability, civil and national security benefits, including the ability to remove debris, refuel or reposition satellites, conduct manufacturing in-orbit and even move industrial activities that are detrimental to Earth into space. An efficient and effective interagency process involving appropriate consultations will be key to a minimally burdensome regime for authorizing in-space missions in a responsible and timely manner. A well-designed and effectively implemented approach will be able to review a variety of applications for in-space activities and appropriately undertake an analysis of their compliance with international treaty obligations and U.S. interests. I encourage Congress to consider an approach modeled more on the commercial remote sensing regulations and less on the launch and reentry regulations. The remote sensing regulations focus on the core capabilities and technologies that are of concern—they are narrowly scoped and intended to be streamlined. Further, the Department of Commerce is experienced with in-space activities whereas such oversight would significantly expand the already stretched capabilities at the FAA, in addition to vastly expanding their scope beyond those activities that may impact the uninvolved public on Earth. Here are some principles to consider:

- *Flexibility and Adaptability:* Regulations must be flexible enough to adapt to the rapid pace of technological innovation in space activities. The regulatory framework should allow for the incorporation of new technologies and operational models as they develop, without necessitating frequent legislative changes.
- *Clear Definition of Agency Roles and Responsibilities:* It is vital to clearly define the roles and responsibilities of different agencies. A streamlined approach should identify which agency has authority over which aspects of space activities, such as mission authorization, traffic management, and safety compliance. This reduces the risk of overlapping jurisdictions and conflicting regulations.
- *Stakeholder Involvement:* Engaging with industry stakeholders, including private space companies and academic institutions, is crucial. Their insights can help shape regulations that are practical and conducive to innovation while maintaining safety and compliance standards.
- *Compliance with International Treaties:* U.S. regulations must be compatible with international treaties and agreements, like the 1967 Outer Space Treaty. This ensures that U.S. space activities are globally recognized and legally sound.
- *Certification and Licensing Procedures:* Develop clear and efficient processes for the certification and licensing of spacecraft, operators, and activities. This process should balance thoroughness with efficiency to avoid unnecessary delays.
- *Transparency and Public Engagement:* Ensuring that the regulatory process is transparent and accessible to the public can help build trust and understanding of space activities. Public engagement also provides a platform for addressing societal concerns related to space exploration.

- *Ongoing Review and Update Mechanisms:* The regulatory framework should include mechanisms for regular review and updates to keep pace with the evolving nature of space activities and address unforeseen challenges.

Diversity of Activities/Regulatory

One thing that our witnesses made clear during the hearing is the diversity of activities in commercial space and human spaceflight. We want that diversity to continue to grow and remain competitive for a robust space economy. An effective regulatory framework will require more than just avoiding duplication and closing gaps between different regulators.

You have noted the rapid pace of companies developing new capabilities in commercial space with varying degrees of human involvement and risk to participants. It is going to require more than clearly defining the proper regulator to ensure a workable regulatory framework keeps up with innovation.

Question 1. What should Congress do to achieve this workable regulatory flexibility that both addresses pressing issues directly and remains adaptable to future issues?

Answer. AI think it is important to ensure that the regulating agency has the resources and structure to adapt to innovative technologies. That flexibility is as much a cultural aspect as it is a structural one. Congress can facilitate flexibility by assigning responsibility to an agency that has proven its ability to engage with industry to modernize its regulations effectively. The Department of Commerce Commercial Remote Sensing Regulatory Affairs office has done that in the course of updating its regulations—it effectively utilized its FACA as well as tools such as advanced notices of proposed rulemaking to receive input on its regulations that were then reflected in its reform efforts.

Commercial Learning Period Ending

We all know that commercial human spaceflight is a heavily regulated industry, especially concerning launch and reentry. Returning to the importance of the learning period, there is a significant uncertainty around the precise impact of the learning period ending.

Question 1. From your perspective as a legal and regulatory expert, what specifically would happen should the learning period expire without Congressional action?

Answer. One risk is that the FAA would delay processing licenses involving human spaceflight while they rushed to write and finalize regulations without adequate engagement with industry or adequate information on which to base the regulations. That could be further detrimental to U.S. commercial human spaceflight if the agency continues to lack the resources and processes to effectively adjudicate license applications. Another risk is a negative impact on innovation.

Insurance/Part 440 Regulations

A vital but often overlooked aspect of commercial human spaceflight is insurance requirements and indemnification. Thankfully damages have not yet exceeded statutorily required insurance coverage for commercial space companies, but the current indemnification rules expire in 2025.

Question 1. Can you explain why it is so critical for investment and protecting the public to modernize the FAA's approach to insurance and indemnification as commercial space grows?

Answer. The public is meant to be protected by the FAA's significant ground and flight safety reviews ahead of granting a launch or reentry license. The insurance and indemnification are a back-up to those thorough safety reviews, which is largely why claims have never threatened to exceed the insurance policies that the FAA prescribes in launch and reentry licenses. It is also important to note that the FAA's insurance and indemnification regime protects the uninvolved public as well as U.S. Government personnel and property. It does not cover property owned or operated by the launch or reentry operator or its customers involved in the launch or reentry. The insurance requirements also satisfy the U.S. Government's interests in not being liable for claims for damages domestically or internationally in compliance with the Outer Space Treaty and Convention on International Liability for Damage Caused by Space Objects. The U.S. has one of the less generous launch indemnification regimes in comparison to China and Russia, where insurance requirements are significantly less and indemnification does not seemingly expire. Launch and reentry customers and investors are interested in an extension as an indication that the U.S. Government is invested in ensuring that a launch or reentry does not become a "bet the company" situation.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TED CRUZ TO
CARYN SCHENEWERK

Government Oversight of Commercial Space Industry

The current commercial space industry is required to interact with several government agencies depending upon the specific mission they are performing. These agencies may include the Federal Aviation Administration (FAA), Space Force, National Aeronautics and Space Administration (NASA), U.S. Department of Commerce, and the Federal Communications Commission.

Question 1. How many agencies and different sets of regulations does a company have to go through to launch and reenter a commercial spacecraft?

Answer. In order to conduct a launch and/or a reentry, a company will likely need to engage with the following regulatory entities: the FAA Office of Commercial Space Transportation for the launch and/or reentry license, which includes the safety and environmental review; the Federal Communication Commission, and possibly the National Telecommunications and Information Administration in the Dept. of Commerce for spectrum use approval; the Dept. of Commerce's Commercial Remote Sensing Regulatory Affairs depending on the type and use of remote sensing capabilities and its Bureau of Industry and Security if an export license is required under the Export Administration Regulations; the Department of State Directorate of Defense Trade Controls if an export license or technical agreement is needed; the Dept. of Transportation's Pipeline and Hazardous Materials Safety Administration for transportation approval if the launch or reentry vehicle is shipped with any hazardous materials on board such as batteries; the Bureau of Alcohol, Tobacco, Firearms and Explosives if the vehicles utilizes any explosive materials; and the U.S. Coast Guard if maritime vessels are involved in launch or recovery operations. If the activities occur from a NASA or U.S. Space Force facility, then the operator will be subject to that agency's requirements and oversight. The list above excludes any state or local approvals that may be required.

Question 2. Do you think this system of regulatory fragmentation is efficient?

Answer. No.

Question 3. Do you think the proliferation of agencies involved in the licensing process is helpful for industry in building, testing, and validating new space launch vehicles? For example, is it helpful in proving the safety and reliability of a rocket, or in building a record of reliability and predictability of a rocket, to have testing put on hold for months while a non-safety-critical agency like the U.S. Fish and Wildlife Service conducts reviews?

Answer. No. Such an approach risks unnecessary increased costs for companies and negative impacts for our national security and civil space interests.

Question 4. What recommendations do you have to improve government efficiency in the licensing of commercial space activities? What are some potential improvements that could be made to create more efficient commercial and government interactions?

Answer. The commercial sector benefits immensely from the use of software solutions for tracking deliverables, processing information, quality control and high-quality results. The licensing of commercial space activities would benefit from implementing similar solutions to track applications, conduct analysis and store and process significant amounts of data in a timely and efficient manner. License review would benefit from more people who are trained and familiar with the technologies and able to engage regularly and meaningfully with applicants. Today, license review is hindered by the lack of automated processes and the small number of people available to review and adjudicate the applications.

Question 5. What do you see as the highest priority areas to be addressed for improvements in the government's role in commercial spaceflight?

Answer. The most pressing need is for revision of FAA's launch and reentry regulations based on industry input as well as investment in the processes and tools used by the FAA's Office of Commercial Space Transportation (AST) to accept and review launch and reentry license applications. The FAA should initiate engagement with industry, including through an "Advanced Notice of Proposed Rulemaking" and reverse industry days to gather direct feedback and recommendations for revisions to 14 CFR Part 450.

Question 6. To your knowledge, does China or Russia have its own version of National Environmental Policy Act¹, or NEPA, under which Chinese or Russian citi-

¹ See 42 U.S.C. 4331(a)

zens or perhaps an obscure conservation group can sue the government and stop space launches or space vehicle development?

Answer. I cannot claim significant familiarity with China or Russia's environmental laws. It is my impression that the level of environmental scrutiny and the power given to the public and interest groups to challenge government decisions in the United States is not commonly paralleled in either China or Russia, especially in areas like space exploration that are closely tied to national security and technological prestige. While China and Russia have environmental laws, it appears as though the scope for public or organizational intervention, particularly in the context of space exploration and technology, is considerably less than what is provided under NEPA in the United States.

Question 7. If a vehicle has already shown that it creates no severe environmental damage or significant environmental impact, do you think that vehicle should have to undergo a new environmental review for every new launch?

Answer. No, the family of launch vehicles and operations should be reviewed as efficiently as possible in a singular review.

Question 8. Mr. Gerstenmaier testified that he saw an inconsistency across the government where NASA is pushing SpaceX to quickly advance vehicle development and the FAA's licensing process is drastically slowing development. Do you think the government adequately harmonizes its national goals, like returning American astronauts to the Moon for example, with its regulatory systems? If not, what do you think is the source of that disconnect?

Answer. The testimony from Mr. Gerstenmaier highlights a significant issue in the realm of U.S. space policy and regulation: the potential misalignment between the ambitious national goals set by entities like NASA and the regulatory processes overseen by bodies such as the Federal Aviation Administration (FAA). This dichotomy brings into question whether the government effectively harmonizes its aspirational objectives, such as returning American astronauts to the Moon, with the practical realities of its regulatory frameworks. The U.S. has also indicated its interest in increasingly utilizing commercial services to support its national security goals. The risk to our national goals should create even more urgency to ensure that we have streamlined licensing processes in place that are well-resourced, efficient and effective in facilitating safety and a thriving, diverse industry.

Question 9. If AST were to establish a "fast lane" regulatory review process for systems directly tied to U.S. capability—like Artemis or national security capability, do you believe this would help ensure a holistic Government approach and ensure continued U.S. leadership in space?

Answer. In my estimation, there are currently few, if any, FAA licensees or license applicants that are not working to provide the U.S. with capabilities that offer national security or civil space benefits. The best solution is an FAA AST that can adjudicate license applications in a timely and efficient manner and, most importantly, in a manner that allows for review of multiple applications and operations in parallel. The current review process appears to operate in series, which is an untenable situation for U.S. national security, civil and commercial space interests.

Question 10. Mr. Gerstenmaier also discussed the need to at least double the resources of FAA's Office of Commercial Space Transportation (AST) to meet the growing workload. What are your views on requiring launch providers to 'pay into the system,' similar to the way in which the Airport and Airway Trust Fund works, to help pay for this growth?

Answer. The significant challenges faced by FAA AST must be addressed. This is an idea that warrants thorough discussion among established and emerging launch providers as well as a study of the Airport and Airway Trust Fund history. Such a review could be a good topic for FAA's Commercial Space Transportation Advisory Committee (COMSTAC) and for the Congressional Research Service with regard to the Trust Fund's history.

Question 11. What specific areas at AST and the Office of Space Commerce do you think need to be addressed to improve government's role in commercial spaceflight?

Answer. The following are suggestions for FAA AST:

- *Resource Enhancement:* AST requires a significant increase in resources, including funding and personnel, to handle the growing number of commercial space activities. This would enable the implementation of software and automation solutions to support more timely processing of licenses and permits.
- *Regulatory Streamlining:* Simplifying and streamlining Part 450 is necessary. This should be prioritized and undertaken with significant industry engagement.

- *Risk Management and Safety Standards:* Continuously updating safety standards and risk management strategies is essential to keep pace with new technologies and mission types. This involves adopting a balanced approach that ensures safety without stifling innovation.
- *Industry Collaboration and Stakeholder Engagement:* Engaging more actively with industry stakeholders can help AST understand and address the industry's needs and challenges, leading to more informed and effective regulations.
- *Technological Expertise:* Investing in the technological expertise of AST personnel is crucial. This includes continuous training and development to ensure that the staff is equipped to assess and understand the latest advancements in space technology.

The Office of Space Commerce should be given oversight of novel space activities and the authorities and resources to engage with industry as it develops regulations that are effective and efficient in their substance and implementation.

Question 12. What should NASA's role be, if any, in the future regulation of commercial human spaceflight?

Answer. NASA is poised to continue to be a valuable customer for commercial human spaceflight and, as such, will play a vital role in shaping some of those capabilities. NASA also has expertise that will be beneficial in formal industry efforts to develop and adopt human spaceflight standards.

Commercial Manned Spaceflight Moratorium and Regulation

Question 1. At the October 18th hearing, Brig. Gen. Wayne Monteith of National Aerospace Solutions who was also the last head of FAA AST, suggested a two-phase approach to the regulation of human spaceflight. Phase 1 would be setting a date before which FAA may not publish new regulations but is allowed to start working on them during that period, and phase 2 would be setting an effective date for those regulations that would occur years after the regulations are published. This gap between the publishing of final regulations and their becoming effective would provide a fail-safe, allowing Congress to intervene in case industry was still not mature enough for the new regulations. In his view, a forcing function is necessary to keep industry and regulators working toward consensus rules. What is your view on this two-phase approach?

Answer. Whether it is a two-phased approach or a single step, the most important aspect is industry engagement and active efforts by the FAA to not over-reach. It is vital that lessons learned from Part 450 be integrated into any regulatory process at FAA AST—the industry should be fully engaged and their input should be significantly reflected in the outcome, not dismissed. The agency must also be fully prepared to engage in regulating the activity. With Part 450, the rule was adopted and FAA AST's team was not prepared nor trained to apply those rules. When the agency regulates, it must have adequate resources and processes to effectively adjudicate license applications. The FAA AST should be engaging with industry, but as long as we still have so few human spaceflights, the ability to regulate as can be done today, and such unique designs, the moratorium should stay in place.

Question 2. In the long term, do you think FAA is the best home for the regulation of commercial spaceflight, or should Congress consider standing up a new, independent entity?

Answer. Instead of further division of regulatory responsibility between Federal agencies for space activities, it is important to recognize the importance of consolidating regulatory oversight, avoiding duplication of efforts and inefficient processes. U.S. space companies are increasingly engaging in innovative activities like satellite servicing, private space stations, in-space manufacturing, and lunar rovers. They are not designing their operations, nor should they, to align with burdensome divisions of responsibility among multiple agencies.

The 2020 National Space Policy, along with industry representatives and congressional legislation, have proposed granting the Department of Commerce's Office of Space Commerce (OSC) the authority to approve commercial in-space and in-situ operations. This recommendation acknowledges the Commerce Department's existing role in regulating in-space activities and its focus on fostering a robust U.S. space industry while protecting national security and complying with international treaty obligations. Such an approach aims to provide a minimally burdensome regime for authorizing in-space missions, emphasizing the need for significant accountability, transparency, and clear timeframes.

To some degree, modeling the legislative approach on the Commercial Space Launch Act (CSLA) makes sense—creating a flexible statute that can effectively review near-term capabilities in a timely and efficient manner, with the flexibility to expand authorities as the industry develops. This strategy avoids trying to predict

all future technologies and risks, instead opting for a flexible approach that ensures treaty compliance and fosters national security. That said, the text of the CSLA is not my suggested starting point, nor do I think the launch and reentry regulations are appropriate—that bill and those regulations are intended to protect the uninvolved public on Earth. They were not drafted to address in-space activities.

An efficient and effective interagency process involving appropriate consultations will be key to a minimally burdensome regime for authorizing in-space missions in a responsible and timely manner. A well-designed and effectively implemented approach will be able to review a variety of applications for in-space activities and appropriately undertake an analysis of their compliance with international treaty obligations and U.S. interests. I encourage Congress to consider an approach modeled more on the commercial remote sensing regulations and less on the launch and reentry regulations. The remote sensing regulations focus on the core capabilities and technologies that are of concern—they are narrowly scoped and intended to be streamlined. Further, the Department of Commerce is experienced with in-space activities whereas such oversight would significantly expand the already stretched capabilities at the FAA, in addition to vastly expanding their scope beyond those activities that may impact the uninvolved public on Earth.

Congress should take action to grant the Department of Commerce authority to review and adjudicate novel space activities in a manner that complies with our treaty obligations. The kinds of activities currently contemplated offer significant economic, space sustainability, civil and national security benefits, including the ability to remove debris, refuel or reposition satellites, conduct manufacturing in-orbit and even move industrial activities that are detrimental to Earth into space.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. J. D. VANCE TO
CARYN SCHENEWERK

Proprietary Data and Intellectual Property

Reluctance to share data has been flagged in several reports as a barrier to standards development and the implementation of voluntary safety systems. These reports point to a variety of solutions, including statutory data protection, programs to facilitate sharing proprietary data, and memorandums of understanding (MOUs) between the Federal Aviation Administration (FAA) and individual companies.

I understand this reluctance to share data. These reports indicate that companies are concerned that any shared data could be traced back to the company due to the small number of providers and the significant differences between their vehicles. Companies view the protection of their data as important for their commercial competitiveness.

Question 1. While commercial companies need to protect their proprietary information, data-sharing between commercial providers will be vital for standards development, collaborative research, and voluntary safety systems. What protections could be implemented to facilitate data-sharing between companies while protecting proprietary data and intellectual property? Would legislation best address this issue, or could agency-led or industry-led measures be effective?

Answer. Agency and industry-led efforts can be effective. That said, the number of entities is still very small (single digits) and the number of operations also small (barely double-digits). The industry is also populated with unique, one-of-a-kind designs, so it's worth considering the fact that the industry has not achieved a level of maturity that would facilitate rapid standard development.

Question 2. How can Congress and the FAA encourage collaboration between industry while protecting proprietary data?

Ohio's Space Capabilities

Ohio is the birthplace of aviation and has a rich tradition of excellence in aerospace. It started with the Wright Brothers, continued with Neil Armstrong and John Glenn, and lives on today with so many people, companies, and universities on the cutting-edge of innovation.

Following in this tradition, Ohio is home to world-class spaceflight testing capabilities not available anywhere else on the globe. But I hear they are often underutilized by commercial partners or even non-NASA Federal partners.

Question 1. NASA/Glenn Research Center in Cleveland has the Agency's lead assignment for future space communication. How best should NASA/Glenn work with the rest of the Federal Government as part of its leadership role in this area, to help fortify commercial space-flight in areas from spectrum licensing to technology

advancement, and does NASA/Glenn have the resources it needs to accomplish this role?

Answer. Ohio's rich heritage in aerospace and its current standing as a hub for spaceflight innovation position it well to contribute significantly to the future of commercial spaceflight. NASA's Glenn Research Center in Cleveland, with its lead assignment in space communication, plays a crucial role in this landscape. For NASA/Glenn to effectively lead in space communication and support commercial spaceflight, a multifaceted approach involving Federal collaborations, technology partnerships, resource optimization, educational initiatives, and innovation promotion is essential. By leveraging its unique capabilities and fostering strong partnerships both within the Federal government and with commercial entities, NASA/Glenn can significantly contribute to advancing space communication technologies and supporting the broader commercial spaceflight sector. Additionally, ensuring that NASA/Glenn is adequately resourced will be pivotal in enabling it to fulfill this leadership role effectively. Specifically, NASA centers can support commercial partners in the following ways:

- **Technology Transfer and Commercial Partnerships:** NASA/Glenn can offer its advanced communication technologies to commercial space entities through technology transfer agreements or partnerships. This can accelerate technological advancements in the commercial sector. To facilitate these agreements, the Center should consider flexibility in its terms and conditions to meet the needs of diverse space companies from start-up to established.
- **Collaborative Research and Development:** Engaging in joint R&D projects with commercial partners can foster innovation in space communication technologies. This could include developing new communication systems for deep space exploration, satellite communications, and more.

Question 2. On October 16, UC Berkeley announced participation in a new \$2B space research park at NASA/Ames in California. In my home State of Ohio, Voyager/Airbus have announced the establishment of the George Washington Carver Science Park on the campus of The Ohio State University, as an integral part of their efforts on *Starlab*, one of NASA's commercial low-Earth orbit destination replacements for the ISS after 2030. What key roles do you see Universities—especially public Universities—playing, in order to maximize the potential success of commercial spaceflight in low-Earth orbit and beyond?

Answer. The involvement of universities, particularly public universities, is pivotal in maximizing the potential success of commercial spaceflight, both in low-Earth orbit and beyond. Their roles span from research and development to workforce training and policy development, forming a cornerstone in the advancement of space exploration and technology. Here are some key roles that universities can play:

- **Research and Development**
 - **Cutting-edge Research:** Universities are often at the forefront of scientific research and technological innovation. They can conduct groundbreaking research in areas crucial for space exploration, such as propulsion systems, life support technologies, materials science, and space communication.
 - **Collaborative Projects:** Universities can collaborate with commercial space companies and government agencies like NASA on specific research projects, leveraging their expertise and facilities to advance space technologies.
- **Workforce Development and Training**
 - **Education and Training:** Preparing a skilled workforce is crucial for the space industry. Universities can offer specialized programs in aerospace engineering, space sciences, and related fields to train the next generation of space professionals.
 - **Internships and Co-ops:** Partnership with commercial space companies for internships and cooperative education programs can provide students with hands-on experience, making them valuable assets to the industry upon graduation.
- **Technology Transfer and Commercialization**
 - **From Lab to Industry:** Universities can play a key role in technology transfer, where research innovations are developed into commercial products or technologies for space applications.

- Startup Incubation: Many universities have incubators and accelerators that can support startups focused on space technologies, providing them with resources, mentorship, and networking opportunities.
- Policy Development and Advocacy
 - Policy Research and Analysis: Universities can contribute to space policy development through research and analysis, helping to shape policies that are conducive to the growth of commercial spaceflight.
 - Public Advocacy: As respected academic institutions, universities can advocate for policies and funding that support the space sector, both at the state and Federal levels.
- Public Engagement and Outreach
 - Educating the Public: Universities can engage in outreach activities to educate the public about space exploration and commercial space endeavors, fostering public interest and support.
 - Hosting Conferences and Forums: Universities can host conferences, workshops, and forums that bring together industry, government, and academic experts to discuss and strategize on the future of space exploration.
- International Collaboration
 - Global Partnerships: Universities often have strong international connections. They can facilitate global research partnerships and student exchanges, contributing to international collaboration in space exploration.

On-Orbit Authority

Question 1. To what extent does the lack of regulatory authority for on-orbit activities affect the commercial human spaceflight industry, if at all?

Answer. The human spaceflight activities that have occurred to date have not been negatively impacted.

Question 2. As the industry prepares for commercial space stations, should a Federal agency be given on-orbit authority that addresses commercial human spaceflight? If so, which agency should be tasked with this authority and why?

Answer. Yes, there is interest in clarifying oversight of future commercial human destinations in Earth's orbit. Those activities are considered in the discussion of a "mission authorization" regulatory regime with wide-spread support for oversight by the Department of Commerce (DOC). Proposals for legislation that have been circulated would continue to have the FAA responsible for launch and reentry and grant the DOC authority over the on-orbit activities. Progress on mission authorization legislation would provide industry-desired certainty regarding the agency with oversight and the opportunity to engage meaningfully in the development of appropriate and efficient regulations.

Question 3. In discussions regarding on-orbit authority or mission authorization, many disagree on whether Commerce or FAA should have this authority. How does commercial human spaceflight factor into these discussions?

Answer. There is wide-spread support for granting the Department of Commerce (DOC) oversight of on-orbit or mission authorization for all activities beyond those regulated by the FAA (launch and reentry) and FCC (telecommunications). The DOC should have clear authority to review and grant approvals for a diverse set of activities, including those that involve human spaceflight. Any legislation granting the authority should include clear timeframes and direction to engage meaningfully with industry to develop appropriate and efficient regulations. Such authorities would allow DOC to lead an inter-agency process and benefit from expertise across various agencies related to the regulated activity.

Miscellaneous

Question 1. The U.S. government is focused on ensuring our obligations under the Outer Space Treaty for mission authorization and supervision under Article 6 are met. With the increase of commercial activities in space, do you believe that this authority should be vested in one Federal agency?

Answer. That would be ideal. Instead of further division of regulatory responsibility between Federal agencies for space activities, it is important to recognize the importance of consolidating regulatory oversight, avoiding duplication of efforts and inefficient processes. U.S. space companies are increasingly engaging in innovative activities like satellite servicing, private space stations, in-space manufacturing, and lunar rovers. They are not designing their operations, nor should they, to align with burdensome divisions of responsibility among multiple agencies.

The 2020 National Space Policy, along with industry representatives and congressional legislation, have proposed granting the Department of Commerce's Office of Space Commerce (OSC) the authority to approve commercial in-space and in-situ operations consistent with the United States' obligation under Article 6 of the Outer Space Treaty. This recommendation acknowledges the Commerce Department's existing role in regulating in-space activities and its focus on fostering a robust U.S. space industry while protecting national security and complying with international treaty obligations. Such an approach aims to provide a minimally burdensome regime for authorizing in-space missions, emphasizing the need for significant accountability, transparency, and clear timeframes.

Question 2. As humans look to operate on orbit and beyond can you speak to lessons learned from commercial launch and how the U.S. government should approach working with commercial companies operating human activities in space moving forward?

Answer. It is vital that lessons learned from the FAA AST's adoption of Part 450 be integrated into any regulatory process at FAA AST or elsewhere—the industry should be fully engaged and their input should be significantly reflected in the outcome, not dismissed. The agency must also be fully prepared to engage in regulating the activity. With Part 450, the rule was adopted and FAA AST's team was not prepared nor trained to apply those rules.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO
WAYNE MONTEITH

Safety Regulatory Framework for In-Space Human Activities

Since 2000, we've seen a constant human presence on-orbit, with astronauts living and working in the International Space Station. In 2021, we saw the first sub-orbital commercial flights from Virgin Galactic and Blue Origin, and the first successful orbital commercial flight with SpaceX's Inspiration4. The space economy is growing rapidly and the landscape for commercial human spaceflight will continue to evolve. Soon we will see commercial destinations in Low Earth Orbit, on-orbit manufacturing and R&D, and potential human habitation on the Moon and Mars.

Question 1. Is it possible to develop a human spaceflight safety framework that would be applicable to all types of vehicles and all operational regimes, or will specific safety approaches and subsequent regulation need to be tailored to specific missions?

Answer. I do not believe a single safety framework for all space vehicle types and orbital regimes is appropriate or possible at this time. An attempt to do so would likely disadvantage some sector of the industry. There are however aspects of the safety equation that can be the same or similar across vehicles, such as requiring a sufficient breathable atmosphere with an appropriate safety margin without mandating the delivery system. Subsequent regulations are likely best suited to vehicle types, or classes, and mission types rather than being overly broad. For example, the regulatory requirements may be vastly different for a low earth orbit (LEO) mission vice a lunar mission.

Mission Authorization

Current FAA regulatory authority covers launch and re-entry of crewed and uncrewed spacecraft but does not extend to on-orbit operations with or without humans. Yet the United States Government, under the 1967 Outer Space Treaty, must authorize and supervise these activities conducted by U.S. entities. I am aware that some in the space community believe that we should extend the FAA's licensing authority to cover all human space activities while providing the Department of Commerce with authority over all in-space mission areas and activities that do not involve humans.

Question 1. What do you view as the most effective division of regulatory responsibility between Federal agencies?

Answer. Fewer regulatory responsibility overlaps are critical, which means fewer regulatory agencies vying for scope within the space regime. In the current regulatory construct AST is responsible during launch and reentry activities, but between those points a literal and figurative void exists. Ideally, DOT would be responsible for all space *transportation* activities and another agency, such as DOC, would be responsible for all other space activities (*i.e.*, on-orbit servicing, asteroid mining, mission authorization, etc.). With that said I believe in the future a single agency should be responsible for all human related space activities for (theoretically) a consistent, predictable, and safer regulatory approach. If a single agency is given

authority for all phases of human spaceflight activities then ideally seams are mitigated which should lead to a safer approach and in an ideal regulatory environment, a streamlined licensing process. By default this agency would be DOT.

FAA's Needs for Commercial Regulation

It is clear that the Federal government must prepare to regulate the commercial human spaceflight industry. This means ensuring our agencies are well staffed, knowledgeable, and ready to regulate. We have heard from stakeholders that the FAA does not have personnel or at least not enough personnel with the right skill sets to begin regulating commercial human spaceflight occupant safety on January 1, 2024.

Question 1. Would adding a key technology leader, such as a Chief Technical Officer or "CTO" at the FAA specific to commercial spaceflight be an effective way to keep its workforce up to speed on the rapid technology changes in industry?

Answer. I do not see a scenario where the FAA would be prepared to fully regulate commercial human spaceflight activities within the next 3–5 years, regardless of number/skills of personnel, because developing a good regulation will take time to be done right. When I was leading AST we had the equivalent of a Chief Engineer and while knowledgeable and hard working a single individual would find it challenging to make a meaningful difference. I do not believe adding a CTO would be sufficient to change the risk averse culture of FAA AST which is a more immediate impediment.

Question 2. Given your experience with FAA/AST from the Federal side, what do you believe the FAA needs to do ensure the safe transportation of humans into, through, and back from space?

Answer. FAA will need to embrace the expertise of the industry they regulate and will need to work closely with industry to develop a minimally sufficient regulatory construct, or "light touch," to foster public safety while not disadvantaging U.S. industry. They will also need sufficient time to develop the new regulation and should be mandated to work closely with industry and the interagency partners. They would also benefit from a rewrite of the outdated Administrative Procedures Act which can and has been interpreted as precluding full and open dialogue with industry.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. KYRSTEN SINEMA TO
WAYNE MONTEITH

Commercial Learning Period Ending

We all know that commercial human spaceflight is a heavily regulated industry, especially concerning launch and reentry. Regarding the importance of the learning period, there is a significant uncertainty around the precise impact of the learning period ending.

Question. From your perspective as a regulatory expert and previous experience as the lead of the Office of Commercial Space Transportation, what specifically would happen should the learning period expire without Congressional action?

Answer. I believe the FAA would be put into a position to rush to develop a regulatory construct for commercial human spaceflight that would likely be overly burdensome, without significantly adding to safety. While commercial space transportation is highly regulated, human spaceflight is not. Part 450 was envisioned to provide a much wider spectrum of technologies and approaches to meet regulatory safety requirements, but it does not appear FAA has embraced the opportunity to meaningfully streamline. I believe this would be consistent regardless of how long the learning period is extended as long as there is no firm sunset date. In other words, industry appears to count on the period being extended while AST notionally works to be ready to regulate. In this situation very little actually gets done to prepare for a new regulation. This is why I've suggested instead of establishing an extension to the learning period Congress should consider establishing a date in which a regulation cannot be published before. This forces industry and the regulator to do the hard work to develop a new regulation and gives Congress the ability to decide when the regulation should become effective. As I recall during testimony, Virgin Galactic suggested extending the learning period another seven years. If you extend for that time and then begin writing a new regulation you are likely eleven to twelve years out from being ready to regulate. If you establish a no earlier than date you could theoretically be ready by the end of the initial seven years and at that point Congress will decide whether it is the appropriate time for DOT to issue the regulation.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN HICKENLOOPER TO
WAYNE MONTEITH

Mission Authorization Framework

During the hearing you stated, “Based largely on my experience with Part 450, my concern remains a very public catastrophic event may drive a rush to regulate, and potentially over-regulate, this still nascent part of the industry.” You also stated continued growth of commercial human spaceflight will be “negatively impacted by either a catastrophic event or an overly burdensome regulatory construct.”

Question. What are examples of targeted regulations that would be constructive in maintaining human safety in space travel to prevent catastrophe?

Answer. My experience with Part 450 taught me that no matter how grand the intentions, either insufficient time to develop a new regulation or insufficient collaboration with industry leads to a less than ideal outcome. Part 450 was envisioned to streamline the regulatory landscape, instead it mostly appears to have created new barriers to entry for U.S. companies or ideas, without adding to public safety. Even though a herculean effort went into developing Part 450, I believe the shortened timeline led to flaws in the regulation and the lack of collaboration with industry further entrenched an “us vs them” mentality with the regulator. Should this same accelerated approach be followed for human spaceflight I would expect an even more draconian approach, again, without a significant increase in safety. If a targeted approach is taken, I would recommend starting with vehicle classes (*i.e.*, winged or traditional rocket) and potentially environmental regimes (*i.e.*, sub-orbital, orbital, cislunar, etc.).

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TED CRUZ TO
WAYNE MONTEITH

Regulatory Reform

Question 1. You provide a unique perspective given your extensive experience with space launch as the Commander of the 45th Space Wing and Director of the Eastern Range, and most recently as the head of the Federal Aviation Administration’s (FAA) Office of Commercial Space Transportation (AST). Do you believe the Part 450 regulations you helped write at AST are working as intended?

Answer. I do not believe the Part 450 regulation is working as intended. The primary purpose of Part 450 was to combine and streamline existing regulations while enhancing safety. It is not obvious that the licensing process has been streamlined, nor that it is faster or less burdensome on U.S. industry, nor that safety has actually been enhanced. I believe it is not just the regulation itself that has some latent issues, but also the way it is being interpreted by FAA.

Question 2. Given your experience serving in the Air Force and later Space Force, rising to the rank of Brigadier General before retiring and going to AST, do you agree rapid and reliable access to space is a critical national security concern?

Answer. I do agree. It is an absolute imperative to national security that the United States have robust, responsive, reliable access to space and a successful commercial space industry in general. One that is not only allowed but is rewarded for innovation and rapid technology development rather than the opposite. The regulator cannot guarantee safety or eliminate risk, no matter how hard they work, but left unchecked they can stifle innovation and disadvantage U.S. industry and national security.

Question 3. In your written testimony, you expressed your concern that movement away from the concept of a regulatory “one stop shop” would impede U.S. leadership in space. What do you think has led to the increase in regulatory fragmentation we’ve seen the last few years and what can Congress do to reverse this trend?

Answer. While I believe commercial space transportation safety is a responsibility of the Department of Transportation, I’ve seen firsthand where having the Office of Commercial Space Transportation (AST) reside in the FAA has led to an overly risk averse regulatory approach that does not add additional safety to a perfect public safety record and may degrade safety. Unfortunately, commercial space transportation licensing responsibility residing within the FAA has proven to be problematic. As industry, Congress and the previous Administration noted prior to the release of SPD-3 FAA AST could not keep up with their existing licensing workload and therefore would likely fail at implementing a manageable space traffic management construct. So, rather than address the problem with either FAA or AST, the safety responsibility was given to DOC’s Office of Space Commerce, further moving away

from the “one-stop-shop” construct. We still have failed to solve the original problem statement that led to the creation of AST.

I would recommend the following for consideration:

- not adding any additional Federal agencies to oversee commercial space transportation
- evaluating the current utilization of staff within AST and then only if necessary, adding limited additional staff for the express purpose of increasing licensing capacity and speed
- move AST back to DOT and report directly to the Secretary for accountability
- designate AST as the responsible agency for space transportation operations and all commercial human spaceflight activities
- move U.S. spaceport licensing responsibility and support to DOC
- make DOC the lead Federal agency for mission authorization, and for all activities other than space transportation and human spaceflight
- ensure DOS are DOC are the lead agencies for U.S. international space efforts, this would enable AST to focus on licensing and supporting the domestic commercial space transportation industry and be in a support role as resources permit

Question 4. Do you think the proliferation of agencies involved in the licensing process is helpful for industry in building, testing, and validating new space launch vehicles? For example, is it helpful in proving the safety and reliability of a rocket, or in building a record of reliability and predictability of a rocket, to have testing put on hold for months while a non-safety-critical agency like the U.S. Fish and Wildlife Service conducts reviews?

Answer. I do not believe having so many agencies involved in the licensing process increases safety, but it does negatively impacts both a robust U.S. space transportation industry and national security. The recent Starship anomaly could not have been much more “spectacular,” but even in this catastrophic event no member of the public was injured or killed and I have not seen evidence that a single animal was killed either. If Federal agencies are left unchecked U.S. industry will have little choice but to look to overseas locations to launch new innovative, disruptive technologies thus ceding U.S. global leadership. The environment is important, but there needs to be a balance based on national priorities.

Question 5. In your experience at AST, to what extent did regulators give any consideration to whether an activity was a national priority or part of the development of capabilities for a program of national significance? That is, did FAA AST ever use any discretion to speed up the licensing or regulating of nationally important capabilities or infrastructure?

Answer. When I served as the head of AST we did prioritize both national security and NASA licensing and mission operations when appropriate. But, I believe this occurred largely because of my previous experience in launch and space operations in the DoD.

a. Could AST even exercise that kind of discretion if it wanted to?

Answer. Yes, workload management and priorities are a call that the Associate Administrator for Commercial Space Transportation can make.

Question 6. In your experience, does AST currently consider the level of international competition from our adversaries such as China and Russia, or the need to maintain U.S. global leadership in space launch capabilities and advanced spaceflight hardware as part of its approach to licensing? If not, do you think they should be as part of either an obligation to protect national security or statutory duty to “encourage, facilitate, and promote commercial space launches and reentries by the private sector?”

Answer. I do not have current insight into the priorities of the Office of Commercial Space Transportation, but my experience suggests this approach would be unlikely. I do believe, consistent with public safety, U.S. global leadership in this sector is imperative for national security and this should be included in FAA AST’s mandate to help prioritize their licensing efforts.

Question 7. Do you think AST correctly balances its safety mandate with fostering innovation, or is AST too risk averse when it comes to the development of new and novel space transportation vehicles?

Answer. I do not believe AST correctly balances its safety mandate with fostering innovation. My experience within AST was that safety was paramount to all licensing activities with no consideration given to the research and development (R&D) type activities. Where I believe the agency fails is that it is too risk averse and at-

tempts to eliminate almost all safety risk at the expense of speed and fostering innovation. The culture of AST is highly influenced by the appropriate safety culture of the mature aviation industry with little acknowledgement of the still nascent stage of development of the commercial space industry. As a reminder, there has never been a death or injury to a member of the uninvolved public as a result of a commercial space mishap. To many this would suggest the record suggests the current system of safety standards is correct, I believe a more relaxed safety standard could have achieved the same results.

Question 8. My belief is vehicles that have launched hundreds of times encounter a smoother and faster time obtaining a launch license than a brand new vehicle or one which has only launched a few times. Do you believe the proven reliability of a vehicle should factor into the speed of the licensing process?

Answer. I believe that a vehicle's proven reliability should absolutely factor into an expedited licensing process, just as the proven success of a company in this sector should factor into the licensing process for their new vehicles. Instead, I encountered many instances where the regulators considered companies that iterated quickly and safely following an anomaly and then improved their vehicles to be reckless and in need of additional oversight rather than less.

Question 9. In the current regulatory environment, with all the red tape mandates such as the National Environmental Policy Act, do you think the United States could stand up a space program and put a man on the moon in under a decade if we were starting from scratch? What about Mars?

Answer. Given the historically overly burdensome behavior of some Federal agencies I would see no path forward to successfully put an American on the moon or Mars in a timely manner if we started from scratch. It will be difficult enough to put an American on Mars within this decade given the heavy hand of the regulators.

Moratorium on Manned Spaceflight Regulation

Question 1. In the long term, do you think FAA is the best home for the regulation of commercial spaceflight?

Answer. I do not believe FAA is the right "home" for regulating commercial spaceflight. At a minimum, Congress should consider moving FAA AST back to DOT reporting directly to the Secretary. Additionally, if the question is specifically referencing commercial human spaceflight I believe the responsibility for all operations should reside with AST so as not to further complicate the licensing process.

a. Should Congress consider moving AST out of FAA or even standing up a new, independent entity?

Answer. See previous response. Additionally, much like the DoD's Space Force, I believe there is merit in exploring a new independent entity for all licensing, supporting, and regulating of commercial space activities . . . truly enabling a "one-stop-shop" for U.S. industry with an eye towards streamlined, expeditious licensing that accepts the idea of "reasonable risk," enables and encourages innovation, fosters a robust U.S. industrial base to enhance national security and ensures continued U.S. global leadership in this sector.

Question 2. If AST were to establish a "fast lane" regulatory review process for systems directly tied to U.S. capability, like Artemis or national security capability, do you believe this would help secure a holistic government approach and ensure continued U.S. global leadership in space?

Answer. I do, but only if Congress is clear on its expectations for the priorities, processes, and timelines within AST and provides oversight to ensure its direction is being effectively implemented.

Question 3. Are there any historical or international precedents for aligning government regulations and agency activities with the schedules of large-scale national space programs, and if so, what lessons can be drawn from these examples?

Answer. I believe the most relevant example is the original human space program. The goal from government was clear and there was a national imperative to move ahead of the Soviet Union. I also believe we face the same challenge today, but primarily from the Chinese government. From my perspective, this means we need to establish the national imperative to be the global leader and then hold all government agencies accountable to program success. If that means being the first to safely establish a human presence on the Moon and Mars then we should be "all in."

Question 4. Do you think there is a way to better organize government oversight and regulation of the commercial spaceflight industry to make it more efficient?

Answer. Any consolidation of oversight responsibilities would likely be helpful. Today there are too many agencies with a stake in the approval process. I believe reasonable licensing timelines for the agency would also be appropriate and if the

deadline is missed then the license should be automatically approved. A good first step would be for DOT to oversee all space transportation responsibilities and human spaceflight, and then DOC would oversee all other aspects.

Question 5. What recommendations do you have to improve commercial spaceflight oversight and regulations?

Answer. I believe Part 450 has the potential to be the streamlined regulation it was intended to be. So, the issue comes down to the quality of the licensing submission by industry and the interpretation of the regulations by the agency and of the quality of the submission. It would help to more clearly define the regulatory/oversight responsibilities of each agency that has the ability to delay a mission.

Question 6. What do you see as the highest priority areas to be addressed for improvements to the Federal government's role in regulation of commercial spaceflight?

Answer. Culture and process. A more reasonable approach to risk assessment (safety management system) in the license application process would be beneficial and clear timelines that must be met to issue a license. In other words, "good enough" now, is often better than "perfect" months or years later.

Question 7. What specific areas at AST and the Office of Space Commerce need to be addressed to improve the Federal government's role in the regulation and licensing of commercial spaceflight?

Answer. AST should focus solely on the licensing process and until the process is improved the office should not be focused or involved in any other perceived responsibilities such as international collaboration, public engagements, etc. This may seem draconian, but with an assertion that current resources are insufficient then national priorities (like NASA's Artemis program) and national security should be their highest licensing priority. DOIC should also focus on their core responsibilities.

Question 8. What should the National Aeronautics and Space Administration's role be, if any, in the regulation or licensing of commercial spaceflight?

Answer. NASA should not become a regulator, but instead have a supporting role in the development of any new regulation on human spaceflight given their long and storied history and deep bench of subject matter experts. FAA should be required to closely and fully collaborate with NASA to utilize and leverage their expertise.

Question 9. At the October 18th hearing, Mr. Gerstenmaier of SpaceX discussed the need for substantially increasing resources at the FAA, advocating for at least doubling the resources of AST to meet the growing workload. What are your views on requiring launch providers to 'pay into the system,' similar to the way in which airlines pay into the Airport and Airway Trust Fund, to help pay for this growth?

Answer. While adding more staff to AST may, or may not, help in the short term it will likely not solve the problem. When I arrived at FAA AST, I believed we had sufficient staff, but we were ineffectively organized, processes were broken, there was a distinct lack of accountability and the team lacked focus. We "fixed" most of the structural and personnel issues, but culture change takes years and continuous attention.

Question 10. In your estimation, are resource constraints at FAA AST the biggest challenge for industry in terms of licensing for commercial space activities?

Answer. No. While resources may be one factor, I believe the risk averse and process focused culture is the limiting factor in licensing efficiency. It is also difficult to determine whether the office is focused on the "right" priorities. If, you accept the argument that additional staff is needed it should only come after an assessment of internal priorities and focus, and workload management is completed.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. J. D. VANCE TO
WAYNE MONTEITH

Proprietary Data and Intellectual Property

Reluctance to share data has been flagged in several reports as a barrier to standards development and the implementation of voluntary safety systems. These reports point to a variety of solutions, including statutory data protection, programs to facilitate sharing proprietary data, and memorandums of understanding (MOUs) between the Federal Aviation Administration (FAA) and individual companies.

I understand this reluctance to share data. These reports indicate that companies are concerned that any shared data could be traced back to the company due to the small number of providers and the significant differences between their vehicles. Companies view the protection of their data as important for their commercial competitiveness.

Question 1. While commercial companies need to protect their proprietary information, data-sharing between commercial providers will be vital for standards development, collaborative research, and voluntary safety systems. What protections could be implemented to facilitate data-sharing between companies while protecting proprietary data and intellectual property? Would legislation best address this issue, or could agency-led or industry-led measures be effective?

Answer. A third party, like an FFRDC, holding and sanitizing the information could be one approach. Establishing an industry safety sharing organization which meets twice a year with an FAA chair to facilitate and provide logistics, but the meeting would entail no recording or minutes, no significant government or public presence, and legislative protections on safety data shared with the government. This would allow industry to come together and freely share data and encourage cross-industry dialogue. Legislative protections would be required to be established in Title 51 similar to the protections in Title 49 for aviation.

Question 2. How can Congress and the FAA encourage collaboration between industry while protecting proprietary data?

Answer. See previous response. I would also add that during my tenure in AST industry expressed concerns that the more data they provided to FAA, the deeper FAA analyzed the new data, and all too often FAA required even more data creating a seemingly endless loop in the licensing process. This occurred without a corresponding increase in safety.

Ohio's Space Capabilities

Ohio is the birthplace of aviation and has a rich tradition of excellence in aerospace. It started with the Wright Brothers, continued with Neil Armstrong and John Glenn, and lives on today with so many people, companies, and universities on the cutting-edge of innovation.

Following in this tradition, Ohio is home to world-class spaceflight testing capabilities not available anywhere else on the globe. But I hear they are often underutilized by commercial partners or even non-NASA Federal partners.

Question 1. NASA/Glenn Research Center in Cleveland has the Agency's lead assignment for future space communication. How best should NASA/Glenn work with the rest of the Federal Government as part of its leadership role in this area, to help fortify commercial space-flight in areas from spectrum licensing to technology advancement, and does NASA/Glenn have the resources it needs to accomplish this role?

Answer. While I could provide an answer through analogy, this specific question is outside my area of expertise.

Question 2. On October 16, UC Berkeley announced participation in a new \$2B space research park at NASA/Ames in California. In my home State of Ohio, Voyager/Airbus have announced the establishment of the George Washington Carver Science Park on the campus of The Ohio State University, as an integral part of their efforts on *Starlab*, one of NASA's commercial low-Earth orbit destination replacements for the ISS after 2030. What key roles do you see Universities—especially public Universities—playing, in order to maximize the potential success of commercial spaceflight in low-Earth orbit and beyond?

Answer. Graduates of Public Universities will become the next generation of innovators and STEM scientists, moving us all into the next frontier. Public Universities provide a wealth of professional research while encouraging student research in vital areas of space transportation and provides excitement building opportunities to encourage United States students to take up the mantle of space exploration, including the potential for a true "space university campus" in LEO.

On-Orbit Authority

Question 1. To what extent does the lack of regulatory authority for on-orbit activities affect the commercial human spaceflight industry, if at all?

Answer. At this time, it does not affect the industry, because there is little regulatory authority currently exercised. As authority is provided to regulate this portion of the industry, then ensuring that one regulatory regime applies from launch to landing will be critical to providing operators with a seamless and clear licensing scheme.

Question 2. As the industry prepares for commercial space stations, should a Federal agency be given on-orbit authority that addresses commercial human spaceflight? If so, which agency should be tasked with this authority and why?

Answer. DOT should be given this authority and responsibility so that there is one and only one license required, and one set of requirements covering space flight participants.

Question 3. In discussions regarding on-orbit authority or mission authorization, many disagree on whether Commerce or FAA should have this authority. How does commercial human spaceflight factor into these discussions?

Answer. Unlike space transportation and other space activities, I believe human spaceflight should be regulated by a single government agency to ensure a single licensing process and a consistent approach to safety.

Miscellaneous

Question 1. As humans look to operate on orbit and beyond can you speak to lessons learned from commercial launch and how the U.S. government should approach working with commercial companies operating human activities in space moving forward?

Answer. Update the APA to allow more effective dialogue between government and industry. Encourage collaboration across all of government and industry to collect and provide results of research into the effects on humans in space. Many research organizations, universities, and companies are working diligently, but the results need to be available to not only the government regulator, but also to industry.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO
SIRISHA BANDLA

Human Spaceflight Occupant Safety

We are entering a golden age for commercial spaceflight. As we see the sharp increase in space launches and witness the first of many fully civilian spaceflights, the safety of those onboard must be a top priority, just as public safety is. In just over a year, we have experienced two significant mishaps with launch vehicles intended for human spaceflight. On September 12, 2022, the Blue Origin New Shepard suborbital rocket suffered a failure a little more than a minute after launch, resulting in the vehicle's emergency abort system jettisoning the capsule away from the booster. On April 20, 2023, SpaceX's first attempt to launch Starship resulted in the catastrophic loss of the vehicle and damage to the launch pad that sent debris as far as five miles from the Boca Chica, Texas launch site.

Question 1. Do your companies have a process for reviewing critical human-safety systems onboard vehicles that have successfully completed commercial human flights to ensure they worked properly?

Answer. As the basis of our business, VG's highest priority is the safety of our crew and spaceflight participants (SFPs). To ensure the safety of our SFPs, VG has created a thorough SFP training program that spans multiple days and goes above and beyond the emergency training required by 14 CFR § 460.51.

To continuously improve our SFP training program, VG collects and uses flight test data, Subject Matter Expert (SME) input, and other information to identify and mitigate safety risks. The following are some examples of the data and actions VG collects and takes to constantly develop our training program (the list is not exhaustive):

- Frame-by-frame analysis of movement in the cabin, identifying if any hazards are presented that have previously gone undocumented.
- SFP safety data collection by flying mannequins ahead of human flights followed by cabin-safety checkouts with trained employees ahead of customer flights.
- A medical screening process for potential SFPs including medical analysis and one-on-one time between a potential SFP and VG's Chief Medical Officer and/or Flight Surgeon

FAA's Needs for Commercial Regulation

It is clear that the Federal government must prepare to regulate the commercial human spaceflight industry. This means ensuring our agencies are well staffed, knowledgeable, and ready to regulate. We have heard from stakeholders that the FAA does not have personnel or at least not enough personnel with the right skill sets to begin regulating commercial human spaceflight occupant safety on January 1, 2024.

Question 1. Given your experience with FAA/AST from the commercial side, what do you believe FAA needs to do to ensure the safe transportation of humans into, through, and back from space?

Answer. FAA must work with industry to determine what a regulatory environment looks like for commercial human spaceflight. Looking at safety frameworks through historical learnings, current lessons learned, and industry consensus stand-

ards will help determine a regulatory framework for occupant safety that prioritizes safety without compromising innovation and industry growth. Without those discussions occurring and a process to look at data and industry standards, it will be hard to determine what the FAA needs to do, as opposed to what it can do.

In addition, FAA also only has authority for launch and re-re-entry. When there is regulatory framework for occupant safety in the future, it should still be limited as such unless future authority is expanded by Congress.

Washington Space Workforce

The launches that we've seen from the companies here today would not have been possible without the engineers, mechanics, and technicians who made these systems possible. My home state of Washington is a prime example of the aerospace and space ecosystem. Our space industry supports more than 13,000 workers, with an economic impact of \$4.6 billion annually. About 5,000 of those workers work at Blue Origin, and more than 1,300 work at SpaceX, creating Starlink satellites. As we move forward in the rapidly changing field of commercial space, we know that these numbers will only grow. It is key that we ensure we have the domestic workforce to keep up with that growth. We're seeing shortages across the STEM fields, with a 60,000-workforce shortage in Washington alone by 2026. Ensuring we have a strong domestic space workforce is key to remaining internationally competitive.

Question 1. What workforce needs and challenges do you see for the commercial space industry?

Answer. The industry needs an increased pipeline of diverse engineering graduates to keep pace with the growing commercial space industry, and especially the government jobs that play a role in industry success—such as FAA, DoC, and others. There should be incentives for government jobs, as they need innovative, technical people in those roles.

Commercial Human Spaceflight Learning Period

While I am a strong proponent of rapid innovation and competition, safety is my top priority. The FAA has the authority to regulate commercial human spaceflight, but Congress instituted a statutory “learning period” that limits the agency's regulatory authority. The learning period for commercial human spaceflight was intended to promote rapid innovation in a nascent industry with few players. And Congress has seen fit to extend this “learning period” three times—in 2012, 2015, and most recently, the latest Continuing Resolution. The learning period will end on January 1st, 2024. Since the 2015 learning period extension, Virgin Galactic and Washington's Blue Origin have carried out successful sub-orbital civilian human spaceflights. And so far, there has only been one purely commercial orbital civilian human spaceflight, SpaceX Inspiration 4—but this is expected to change according to the testimony we have heard today. As we've seen from the rapidly increasing cadence in flights and in testimony today, the commercial space industry is poised to go far beyond the industry we saw in past learning period extensions.

Question 1. Can you explain what your company still needs to learn about keeping your spaceflight participants safe? How much longer do you believe the current learning period should be extended beyond January 1, 2024?

Answer. The learning needed for a successful transition to a permanent safety framework for occupant safety is not company specific but collective. It requires FAA and industry to work together to discuss what a safety framework looks like and determine the resources necessary to successfully enact it—these discussions have not yet been completed. If the Learning Period were to expire—it would basically be an unfunded mandate; stretching AST's resources even further and competing with its current primary authority of protecting the uninvolved public and property. Underfunded, under resourced, and potentially under pressure to get rules out in case an incident happened when there is no learning period could lead to regulations that may have unintended consequences on the growth of this industry.

VG proposes extending the learning period 8 years to provide for a transition period utilizing the collection of data and for the standards development process to properly inform future safety frameworks. This transition period should incorporate the development of an initial set of industry consensus standards that covers appropriate aspects of spaceflight participant safety, an evaluation of the practical applications of these standards, and an evaluation of FAA AST's readiness to transition to a safety framework, including their execution of existing statutory requirements like launch and reentry licensing.

The transition period process would create a deadline for developing an initial set of industry consensus standards that covers appropriate aspects of spaceflight participant safety. The road mapping for an initial set of human occupant safety standards should be done through a standards development organization, such as those

currently being developed by standards development organizations, primarily ASTM, and/or an industry/government advisory group and would include FAA AST participation in the development and balloting process.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TED CRUZ TO
SIRISHA BANDLA

Question 1. As the only company to go through the accident investigation process with the VSS Enterprise crash, Virgin has a unique perspective on the moratorium on Federal Aviation Administration (FAA) promulgating regulations for human spaceflight. Do you think the current system ensures the safety of the general public, as well as spaceflight participants, while giving commercial space companies enough flexibility to innovate?

Answer. The current system has a proven and perfect safety record for the safety of the general public.

For human spaceflight, Congress aptly acknowledged the emergence of the commercial industry, recognizing that it is in a dynamic and iterative, 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 the FAA may regulate for the safety of the public, or in response to an incident. During this period, the FAA is still able to issue regulations governing the design or operation of a vehicle to protect the health and safety of crew, government astronauts, and spaceflight participants (under certain conditions). It is important to note that the current regulations that cover operations and public safety also provide indirectly for occupant safety—creating a vehicle that operates with no impact to public safety, inherently creates a vehicle that is safe for its occupants to an extent.

Question 2. At the October 18th hearing, Brig. Gen. Wayne Monteith of National Aerospace Solutions, who was also the last head of the FAA Office of Commercial Space Transportation (AST), suggested a two-phase approach to the regulation of human spaceflight. Phase 1 would be setting a date before which FAA may not publish new regulations but is allowed to start working on them during that period, and phase 2 would include setting an effective date for those regulations, which would occur a number of years after the regulations are published. This gap between the publishing of final regulations and their becoming effective would provide a fail-safe, allowing Congress to intervene in case industry was still not mature enough for the new regulations. In his view, a forcing function is necessary to keep industry and regulators working toward consensus rules.

a. What does Virgin Galactic think of this proposal?

Answer. While we don't oppose the thought process behind the proposal, it is important that the learning period not expire ahead of setting a plan for a future safety framework the learning period is needed for a successful transition to a permanent safety framework. It requires FAA and industry to work together to discuss what a safety framework looks like and determine the resources necessary to successfully enact it. These discussions have not yet been completed. If the Learning Period were to expire—it would represent an unfunded mandate; stretching AST's resources even further and competing with its current primary authority of protecting the uninvolved public and property. Underfunded, under resourced, and potentially under pressure to get rules out in case an incident happened when there is no learning period could lead to regulations that may have unintended consequences on the growth of this industry.

Question 3. As Mr. Gerstenmaier testified, SpaceX is facing significant licensing challenges as it works to test and certify its next generation launch vehicle. Does Virgin Galactic have any similar challenges currently, or foresee any challenges with the government licensing process as it looks to increase your flight rate?

Answer. As commercial launch cadence increases and commercial operators transition to Part 450, AST's resources should increase accordingly. The FAA is not currently resourced to process launch and reentry applications in a timely manner while working on the Part 450 transition. Due to lack of additional resources, current resources are rightfully focused on licensing upcoming launch and re-entries—and should continue to do so.

Congress should authorize research, engineering, and development funding for AST to develop a suite of tools to automate parts of the licensing process and help license evaluators handle the growing workload. Virgin Galactic also recommends

authorizing resources for additional FTEs to work through the increased launch cadence in the pipeline and Part 450 transition.

Question 4. Mr. Gerstenmaier also discussed the need to at least double the resources of FAA's AST to meet the growing workload. As a commercial launch company working to certify launch vehicles and obtain licenses for launch and reentry from FAA AST, what are Virgin Galactic's views on requiring launch providers to 'pay into the system,' similar to the way in which the Airport and Airway Trust Fund works, to help pay for this growth?

Answer. Aviation taxes that pay into the AATF are often passed to consumers and spread across a high volume of passengers and flights. While the frequency and volume of commercial space operations is increasing, it will not likely support sufficient revenue generation without significantly increased burdens on providers and customers. At this time, Virgin Galactic believes that a revenue structure based on aviation taxes and fees may jeopardize the competitiveness and growth of the U.S. commercial launch sector. However, as institutions evaluate future budgetary needs and revenue structures—it is imperative to look at equitable ROI for all operators involved.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. J. D. VANCE TO
SIRISHA BANDLA

Proprietary Data and Intellectual Property

Reluctance to share data has been flagged in several reports as a barrier to standards development and the implementation of voluntary safety systems. These reports point to a variety of solutions, including statutory data protection, programs to facilitate sharing proprietary data, and memorandums of understanding (MOUs) between the Federal Aviation Administration (FAA) and individual companies.

I understand this reluctance to share data. These reports indicate that companies are concerned that any shared data could be traced back to the company due to the small number of providers and the significant differences between their vehicles. Companies view the protection of their data as important for their commercial competitiveness.

Question 1. While commercial companies need to protect their proprietary information, data-sharing between commercial providers will be vital for standards development, collaborative research, and voluntary safety systems. What protections could be implemented to facilitate data-sharing between companies while protecting proprietary data and intellectual property? Would legislation best address this issue, or could agency-led or industry-led measures be effective?

Answer. The purpose of data-sharing is to look at lessons learned and provide for collaborative standards development that could be used for future safety frameworks. However, the number of commercial operators is small, and the diversity among the vehicles is significant.

Virgin Galactic believes that there are already collaborative methods in place to achieve the same end objective through discussion forums within SpARCs via the FAA, and standard-making bodies like ASTM. These discussions will yield standards development, identify areas for collaborative research, and provide guidance for future safety systems.

Question 2. How can Congress and the FAA encourage collaboration between industry while protecting proprietary data?

Answer. Congress should continue to encourage collaboration in current established channels—each of which provide an opportunity for industry and government to discuss future human spaceflight frameworks and interim work that needs to be done. These established channels include COMSTAC, SpARCs, and standard making organizations such as ASTM's F47 committee. All of these channels are sufficient enough for industry and government to engage in dialogue and exchange the needed information to formulate recommendations for future safety frameworks, policies, and regulations.

Ohio's Space Capabilities

Ohio is the birthplace of aviation and has a rich tradition of excellence in aerospace. It started with the Wright Brothers, continued with Neil Armstrong and John Glenn, and lives on today with so many people, companies, and universities on the cutting-edge of innovation.

Following in this tradition, Ohio is home to world-class spaceflight testing capabilities not available anywhere else on the globe. But I hear they are often underutilized by commercial partners or even non-NASA Federal partners.

Question 1. NASA/Glenn Research Center in Cleveland has the Agency's lead assignment for future space communication. How best should NASA/Glenn work with the rest of the Federal Government as part of its leadership role in this area, to help fortify commercial space-flight in areas from spectrum licensing to technology advancement, and does NASA/Glenn have the resources it needs to accomplish this role?

Answer. NASA/Glenn should continue to participate through NASA HQ on industry collaboration initiatives and road-mapping. NASA has done a great job conducting industry round-tables to identify any general and unique needs—and this is a great venue to continue to do so and identify any specific areas of interest for NASA Glenn.

Question 2. On October 16, UC Berkeley announced participation in a new \$2B space research park at NASA/Ames in California. In my home State of Ohio, Voyager/Airbus have announced the establishment of the George Washington Carver Science Park on the campus of The Ohio State University, as an integral part of their efforts on *Starlab*, one of NASA's commercial low-Earth orbit destination replacements for the ISS after 2030. What key roles do you see Universities—especially public Universities—playing, in order to maximize the potential success of commercial spaceflight in low-Earth orbit and beyond?

Answer. Universities have played and continue to play a role in R&D surrounding technologies and science for further exploration and expansion of our knowledge base. Universities have utilized suborbital capabilities—through the NASA Flight Opportunities program—to test technologies ahead of flights to Earth orbit and beyond. This utilization has created a robust pipeline from suborbit to orbit—allowing for technologies to be tested at a higher rate and potentially creating a higher probability for success when deployed on a longer (and more permanent) spaceflight journey.

On-Orbit Authority

Question 1. To what extent does the lack of regulatory authority for on-orbit activities affect the commercial human spaceflight industry, if at all?

Answer. Commercial space companies are well underway in designing technologies and business plans for on-orbit and beyond operations. Now is the time to for an agency to start discussions with industry on what future light-touch regulatory approaches should look like for an effective future regime. Unexpected regulations in the future when companies are already invested and continuously operating on-orbit could be costly and slow the growth of the industry.

Question 2. As the industry prepares for commercial space stations, should a Federal agency be given on-orbit authority that addresses commercial human spaceflight? If so, which agency should be tasked with this authority and why?

Answer. While VG does not have any current plans for on-orbit activities, VG is part of the Commercial Spaceflight Federation—a trade association of commercial spaceflight companies, and is aligned with the association's position that these types of activities fall outside the regulatory authority and expertise of the FAA. Any entity that manages these activities should utilize the interagency process and incorporate presumed approval, self-certification, and defined timelines to foster a vibrant and innovative U.S. commercial space industry. The Office of Space Commerce is uniquely positioned to do that.

Question 3. In discussions regarding on-orbit authority or mission authorization, many disagree on whether Commerce or FAA should have this authority. How does commercial human spaceflight factor into these discussions?

Answer. Commercial human spaceflight does not need to specifically factor into these discussions as any process being discussed should look at a streamlined authority that allows for all range of activities being planned on-orbit.

Miscellaneous

Question 1. As humans look to operate on orbit and beyond can you speak to lessons learned from commercial launch and how the U.S. government should approach working with commercial companies operating human activities in space moving forward?

Answer. The commercial space industry has seen incredible growth in the past two decades—rapidly advancing technologies, growing commercial markets, supporting critical USG missions, and reclaiming market share from foreign competitors like China. This, along with the perfect public safety record of the industry, demonstrates that a light-touch, performance-based regulatory structure works. As the industry continues to advance technologies and capabilities with commercial human spaceflight, we should:

- Engage in industry-government dialogue whenever possible ahead of rule-making activities
- Pursue performance-based, light-touch regulation wherever possible that prioritizes safety without discouraging innovation
- Continue to revisit established regulations at a regular cadence to ensure they are keeping up with evolving industries and,
- Ensure that regulatory agencies are properly resourced to keep up with the growth of the industries for which they are responsible.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO
WILLIAM H. GERSTENMAIER

Human Spaceflight Occupant Safety

We are entering a golden age for commercial spaceflight. As we see the sharp increase in space launches and witness the first of many fully civilian spaceflights, the safety of those onboard must be a top priority, just as public safety is. In just over a year, we have experienced two significant mishaps with launch vehicles intended for human spaceflight. On September 12, 2022, the Blue Origin New Shepard suborbital rocket suffered a failure a little more than a minute after launch, resulting in the vehicle's emergency abort system jettisoning the capsule away from the booster. On April 20, 2023, SpaceX's first attempt to launch Starship resulted in the catastrophic loss of the vehicle and damage to the launch pad that sent debris as far as five miles from the Boca Chica, Texas launch site.

Question 1. If humans had been aboard these missions, what safety measures would have prevented loss of life?

Answer. Starship Flight 1 was an uncrewed experimental test flight with specific goals to learn about new technology employed on the vehicle, including new engines and operational approaches, and was not in a configuration designed to carry humans. SpaceX openly communicated prior to this test flight that the objective was to gather data to inform and improve vehicle design and operations. SpaceX would not put crew on such a vehicle or an experimental flight like Starship Flight 1.

For Starship Flight 1, all vehicle operations were conducted in full compliance with FAA licensing requirements, which protect the safety and property of the uninvolved public. The long-standing goal of the U.S. regulatory system has, appropriately, been to protect public safety, not to ensure mission success, especially for uncrewed test flights. In experimental test flights, things may not go as planned, and it is not unexpected that a loss of vehicle occurs. This is inherent to any valid test regime. The ultimate objective should be to maximize learning, while ensure the public is protected. SpaceX has developed a robust, hardware-rich test approach to meet these objectives. This appropriate balance allows for rapid, responsible innovation that improves the long-term safety of vehicle systems. Continued U.S. competitiveness and the success of NASA's Artemis Program are directly tied to this framework.

SpaceX is committed to operating the safest vehicles systems possible, and uses early vehicle tests to demonstrate operations and rapidly mature capabilities well in advance of any crewed missions. This rapid iteration is necessary to eventually get to a future with airplane-like operations. Premature regulations inappropriately focused on mission success, rather than protecting public safety, risk freezing the industry in an early stage, slowing or inhibiting the development of technologies that would ultimately materially improve safety.

Question 2. Do your companies have a process for reviewing critical human-safety systems onboard vehicles that have successfully completed commercial human flights to ensure they worked properly?

Answer. Yes. We carefully review every flight and make sure that the vehicle and systems operate as designed. This learning enables important ongoing improvements to system reliability and is enhanced at SpaceX by a high flight rate that provides tremendous insight into vehicle design and operations. All systems and modifications to systems are flown and proven on uncrewed flights, prior to any flight with humans on board.

Regulating Spaceflight Occupant Safety

While I am a strong proponent of innovation and competition, safety is my priority. The potential for a catastrophic incident on a commercial tourism spaceflight could have a significant negative impact on not just the human spaceflight industry, but on the economic competitiveness of the U.S. commercial space industry as a whole.

Question 1. You say in your testimony that it is not the responsibility of the FAA's Office of Commercial Space Transportation to "ensure the success of a space launch or reentry." Do you believe that the Federal government plays no role in ensuring commercial space flights do not result in the death of anyone on board?

Answer. Both the Government and industry share a common goal: ensuring safety. It is a question of timing as to if and when it would be appropriate to establish a more expansive regime of occupant safety regulations. As noted in my testimony, both launch vehicles and spacecraft are early in their design cycles and continue to see significant changes in design and operational concepts. This rapid iteration is necessary to eventually get to a future with airplane-like operations. Premature occupant safety regulations risk freezing the industry in an early stage, slowing or inhibiting the development of technologies that would materially improve safety.

Importantly, the present framework appropriately requires a robust informed consent process that provides space flight participants with highly detailed insight into vehicle operations, as well as requirements on environmental control and life support systems (ECLSS), training, and more. Additionally, this is a much-strengthened form of informed consent than is used in many adventure sports, like skydiving.

Industry is committed to developing and strengthening consensus safety standards. The Government should continue to facilitate and promote this effort to improve safety.

Question 2. What would the impact be on the commercial spaceflight industry should a death occur during a commercial space tourism flight while the moratorium is in effect?

Answer. I cannot speculate on hypotheticals. SpaceX is committed to making human spaceflight as safe as possible. However, spaceflight is inherently a high-risk activity, as Congress has previously noted, and any spaceflight participants need to be informed of the risks, as is required under FAA's Part 460 regulations today. Spaceflight participants must make an educated decision, with full recognition of the risks involved in any launch or reentry. The current regulatory regime is appropriate for the state of the industry and technology.

Washington Space Workforce

The launches that we've seen from the companies here today would not have been possible without the engineers, mechanics, and technicians who made these systems possible. My home state of Washington is a prime example of the aerospace and space ecosystem. Our space industry supports more than 13,000 workers, with an economic impact of \$4.6 billion annually. About 5,000 of those workers work at Blue Origin, and more than 1,300 work at SpaceX, creating Starlink satellites. As we move forward in the rapidly changing field of commercial space, we know that these numbers will only grow. It is key that we ensure we have the domestic workforce to keep up with that growth. We're seeing shortages across the STEM fields, with a 60,000-workforce shortage in Washington alone by 2026. Ensuring we have a strong domestic space workforce is key to remaining internationally competitive.

Question 1. What workforce needs and challenges do you see for the commercial space industry?

Answer. Both in Washington and more broadly across the United States, it is vital that there are responsible policies to expand a qualified, diverse technical workforce for vehicle design, manufacturing, and processing. A workforce shortage is impacting all facets of the space industry, as well as the Government. For example, FAA AST has acknowledged it requires significantly more employees with technical backgrounds to support the cadence of licensing in a timely manner. We also need to expose students at an earlier age to the opportunities available for them in spaceflight.

Commercial Human Spaceflight Learning Period

While I am a strong proponent of rapid innovation and competition, safety is my top priority. The FAA has the authority to regulate commercial human spaceflight, but Congress instituted a statutory "learning period" that limits the agency's regulatory authority. The learning period for commercial human spaceflight was intended to promote rapid innovation in a nascent industry with few players. And Congress has seen fit to extend this "learning period" three times—in 2012, 2015, and most recently, the latest Continuing Resolution. The learning period will end on January 1st, 2024. Since the 2015 learning period extension, Virgin Galactic and Washington's Blue Origin have carried out successful sub-orbital civilian human spaceflights. And so far, there has only been one purely commercial orbital civilian human spaceflight, SpaceX Inspiration 4—but this is expected to change according to the testimony we have heard today. As we've seen from the rapidly increasing

cadence in flights and in testimony today, the commercial space industry is poised to go far beyond the industry we saw in past learning period extensions.

Question 1. Based on your years of experience with human spaceflight, what is your answer to this question? How do you think we should provide government oversight of in-space commercial human activities?

Answer. There is little evidence that commercial *human* spaceflights will dramatically increase in the near-term, particularly *orbital* human spaceflights. This segment of the industry remains exceptionally nascent in both technology and market demand. The Government has significant insight and oversight of commercial human spaceflight activities today. The current regulatory regime appropriately balances public safety with innovation, while providing for reasonable, responsible occupant safety requirements within the existing Part 460 framework. Additionally, FAA should continue to facilitate and promote the development of consensus industry safety standards that strengthen safety while providing a flexibility pathway that allows for necessary technological development.

Notably, the *only* orbital human spaceflight system currently in operation in the U.S. is SpaceX's Dragon system, which is certified by NASA.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. KYRSTEN SINEMA TO
WILLIAM H. GERSTENMAIER

Mission Authorization

While working closely with NASA to launch government astronauts to the International Space Station, SpaceX has also invested in launching private astronauts into space. In working with Axiom and launching the Inspiration 4 crew, SpaceX is clearly thinking ahead on commercial operations in space that are privately led, rather than contracted by the government. However, this has opened a new facet of the industry when we think about classification of human spaceflight participants. The ability for private companies to train non-government astronauts and conduct commercial operations in low Earth orbit is a true game changer.

Of course, under current law there is no defined regulator with "mission authorization" authority or a clear understanding of how different classifications of astronaut's impact how in-space activities should be regulated.

Question. As Congress works to clarify agency authority and remove uncertainty over novel space activities, what are the critical components to create a workable, efficient, and safe regulation regardless of who is participating, such as a private citizen or government astronaut?

Answer. Any mission authorization regime must be light-touch with a presumed approval model that enables the next-generation of American space exploration and commerce to thrive, while ensuring compliance with national security objectives and international treaty obligations. It would be premature to establish on-orbit regulation of occupant safety.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN HICKENLOOPER TO
WILLIAM H. GERSTENMAIER

Mission Authorization Framework

A recent FAA assessment states by 2035, if the expected large constellation growth is realized and debris from satellites survive reentry, satellites disposed from these constellations could injure or kill one person on the planet every two years.

Question 1. How should Federal agencies consider "safety" as an aspect of licensing or authorizing in-space activities? How should agencies consider the possibility of satellites or spacecraft reentering our atmosphere without disintegrating?

Answer. The recent assessment performed by the Aerospace Corporation for FAA is deeply flawed, lacks fundamental technical rigor, and should be disregarded. SpaceX submitted a letter to the FAA identifying the flaws in the Aerospace Corp. analysis. SpaceX understands Aerospace is reviewing and likely revising its report. SpaceX has generally called for zero casualty risk and full demisability in relation to satellite reentry. If a satellite does not demise, reentry should be targeted to an unpopulated region of the Earth, consistent with long-standing practice. Current regulations are appropriate for disposal.

SpaceX recommends standards be developed and a single agency—the Department of Commerce—be charged with working with technical authorities and industry to develop best practices and standards as it relates to space safety.

Human Spaceflight Safety

There are several ways to calculate collision risk— in aggregate over all of LEO, or individual-satellite basis. The Federal Communications Commission has examined this issue in recent years, as growth in satellite constellations for communications purposes continues to rise and expand connectivity on Earth.

Question 1. How should Federal agencies accurately calculate collision risk to maintain the safety of all operators, assets, and humans in space?

Answer. Aggregating collision risk is a flawed approach because it makes the incorrect assumption that a smaller constellation with unreliable, low-performing satellites is *less risk* than a larger constellation of highly reliable, high-performing satellites.

In general, SpaceX recommends that an independent technical authority (e.g., NASA) work in tandem with satellite owners/operators to establish technical metrics for different types of satellite systems and different orbital regimes. Satellite systems are not identical, and there is no “one size fits all” approach that ensures space safety. Rather, Congress should provide resources that facilitate the development of specific, measurable requirements that adequately consider multiple relevant factors, including operating altitude, propulsion capability, etc. to ensure a performance-based regulatory system. This approach far more effectively categorizes risk than utilizing a single factor—for example, number of satellites. NASA has specifically opposed in technical papers efforts to apply a single risk calculation across satellite systems for this reason.

At SpaceX, all Starlink satellites have highly sophisticated onboard collision avoidance capabilities, and Starlink has set the industry standard by openly publishing the location of all of our satellites. SpaceX has also worked with industry and the AIAA to publish best practices: <https://www.ascend.events/outcomes/satellite-orbital-safety-best-practices-by-iridium-oneweb-spacex-aiaa/>.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TED CRUZ TO
WILLIAM H. GERSTENMAIER

Starship

The National Aeronautics and Space Administration (NASA) awarded the human landing system (HLS) contract to SpaceX in April 2021. The testing and development of Starship is critical to SpaceX having a human-rated lander ready for NASA's Artemis 3 mission when it intends to put astronauts back on the Moon. Earlier this summer, NASA expressed concerns over meeting timelines and key targets for the Moon to Mars program. At the hearing, I asked you, if you were still at NASA, would these delays to HLS be acceptable, to which you stated they would not.

Question 1. How much of a factor is the Federal Aviation Administration (FAA)'s slow licensing process in the development of Starship and, consequently, HLS?

Answer. Continued FAA Office of Commercial Space Transportation (AST) licensing delays, including for environmental approval, are highly consequential and harmful to the development of Starship and SpaceX's ability to support NASA in the HLS Program. These delays are slowing the HLS effort and American technological progress. SpaceX's and the HLS Program's developmental approach requires a high flight rate and fast learning. SpaceX has the hardware ready and engineering expertise in place to support this national objective. The technical work to successfully return Americans to the Moon is highly challenging and operating in an uncertain regulatory environment makes it almost impossible to make efficient progress.

Question 2. Given NASA's Artemis 3 mission target date for 2025, how will FAA's continued licensing delays impact SpaceX's Starship cost and schedule?

Answer. Continued AST license delays materially impact the Artemis 3 mission target date. As I noted in my oral testimony, China may beat the United States back to the Moon if changes are not made to reform the AST launch and reentry license regime.

SpaceX has a series of developmental objectives and flights planned with NASA for this program. In order to safely land astronauts on the Moon in a time-frame that meets NASA's needs, we must demonstrate reliable Starship operations. The path to reliability involves a steady pace of flight tests. We have the hardware ready, but cannot efficiently test in an uncertain regulatory regime.

Question 3. Given the disparate treatment from NASA and the FAA, where NASA is pushing SpaceX to quickly advance vehicle development and the FAA's licensing

process is drastically slowing development, is SpaceX concerned these two agencies are misaligned in advancing Starship?

Answer. The Part 450 regulatory framework is disconnected from national priorities, including Artemis. Launch and reentry licensing—whether for test flights or operational missions—should never take longer than rocket development. Urgent improvements to Part 450 are required, including opportunities to expedite licensing reviews for projects of national importance, to appropriately re-align these regulations with key national objectives. We share NASA’s desire for advancing development and returning to the Moon as soon as possible. Rapid, safe development is required to keep the U.S. a leader in space.

Question 4. On October 31, FAA announced it had completed the safety review portion of the SpaceX Starship-Super Heavy license evaluation for the Starship 2 license. However, the FAA stated it is “continuing to work on the environmental review” and “as part of its environmental review, the FAA is consulting with the U.S. Fish and Wildlife Service (USFWS) on an updated Biological Assessment under the Endangered Species Act.¹ The FAA and the USFWS must complete this consultation before the environmental review portion of the license evaluation is completed.”²

a. Is any part of this environmental review critical to the safe flight of the rocket?

Answer. No.

Question 5. How much of a delay does SpaceX anticipate from this additional environmental review?

Answer. The additional environmental review for Starship Flight 2 was concluded the week of November 13. However, action must be taken to ensure that future reviews do not add continued delays, which if taken in the aggregate could be significant over the course of Starship development and operation. SpaceX is committed to protecting the environment, but the serial review and bureaucratic process involved in licensing today are not helping to protect the environment or advance national priorities in space.

Question 6. Does SpaceX think this cadence of review for every Starship launch is sustainable?

Answer. The present cadence of regulatory review is not sustainable, and the regulatory framework is at a breaking point. NASA and its partners will not be able to meet national goals in space with the current regulatory process.

Question 7. How much of an additional delay will such a prolonged licensing process cause for vehicle development?

Answer. Without improvement, continued licensing delays could add years to vehicle development for SpaceX and the broader national launch and reentry enterprise—during which America’s geopolitical rivals, including China, will continue to rapidly develop their own capabilities without a similar regulatory burden. The country that develops new technology first sets the rules engagement for all others that follow. Ongoing U.S. licensing and environmental delays could let China set the future environmental and spaceflight rules and norms. Allowing China to take leadership on these decisions will be unacceptable for the free world.

National Security and Programs of National Interest

Question 1. Reporting shows that China plans to send at least two rockets to the moon by the end of 2030, with one carrying a spacecraft that will transport astronauts and the other landing on the surface of the moon.³ Further, China is developing its own super-heavy carrier rocket to meet their intended goals.

a. Does SpaceX see significant competition on the horizon from China given their goal to outpace the United States in lunar exploration?

Answer. Yes.

Question 2. In your estimation, does this kind of direct competition present a national security threat?

Answer. Yes. We will lose our global competitive advantage. Space exploration is critical to a country’s ability to maintain ‘soft power’.

Question 3. To your knowledge, does China or Russia have its own version of National Environmental Policy Act⁴, or NEPA, under which Chinese or Russian citi-

¹Neumann, Daniel G. ‘SpaceX Starship-Super Heavy License Evaluation.’ FAA. E-mail to Senate Commerce Committee, 2023.

²*Ibid.*

³“China plans to send two rockets for crewed moon landing.” *Reuters*. July 12, 2023. <https://www.reuters.com/technology/space/china-plans-send-two-rockets-crewed-moon-landing-2023-07-12/>

⁴See 42 U.S.C. 4331(a)

zens or perhaps an obscure conservation group can sue the government and stop space launches or space vehicle development?

Answer. To my knowledge, regulations are not a concern for the national space programs of China and Russia, or for any state-sponsored “commercial” entities operated by their citizenry. China’s orbital debris policy and past anti-satellite test are in direct opposition to appropriate policy. The slowness in our regulatory processes is allowing China’s non-policy to effectively set the policy for the future. We need to compete with effective and agile policies.

Question 4. In your testimony, you mentioned that for programs of national interest, such as NASA’s Artemis missions, it is necessary for Congress to establish a regulatory regime consistent with our national program objectives and schedules. Which key aspects of Part 450 regulations do you believe require modification to accommodate timelines of national interest and associated schedules?

Answer. SpaceX has provided specific areas for legislative consideration to the Committee that would address this issue. Additionally, SpaceX agrees with the Part 450 recommended updates and clarifications put forward by the Commercial Space Transportation Advisory Committee (COMSTAC). AST should be empowered to evaluate programs directly related to USG programs of national interest or capability with different tiers of risk, accelerated review schedules, and accelerated timelines for environmental reviews.

Question 5. If AST were to establish a “fast lane” regulatory review process for systems directly tied to U.S. capability—like Artemis or national security capability, do you believe this would help ensure a holistic Government approach and ensure continued U.S. leadership in space?

Answer. Yes, this is a critical action. I strongly support this holistic approach. It is necessary to properly align all stakeholders in the regulatory process in support of national priorities and leadership.

Question 6. Are there any historical or international precedents for aligning government regulations and agency activities with the schedules of large-scale national space programs, and if so, what lessons can be drawn from these examples?

Answer. Foreign competitors, notably China and Russia, do not consider government regulations in any meaningful sense when proceeding through national space programs. While the United States should have a regulatory regime that appropriately protects public safety, it needs to ensure that these regulations are being considered as part of the national prerogative to remain a leader in space.

The most important historical precedent is the Apollo Program, in which the U.S. Government—across every agency—holistically worked to achieve this national space priority less than seven years after it was announced. Without this alignment of resources and intent, this triumph and subsequent victory over the Soviet Union in the Space Race may not have occurred. The United States would do well to ensure it maintains this shared urgency of purpose today across all agencies, including regulatory authorities.

Question 7. In the current regulatory environment, with all the red tape mandates such as the National Environmental Policy Act, do you think the United States could stand up a space program and put a man on the moon in under a decade if we were starting from scratch? What about Mars?

Answer. It would be highly unlikely unless changes are made. The Apollo Program was recognized as national priority and key to U.S. leadership. Formal congressional recognition of the criticality of the Artemis Program could be helpful. The present launch and reentry regulatory regime is not capable of facilitating the rapid innovation necessary to return Americans to the Moon, let alone of ensuring America is the first nation to send its citizens to Mars. Implementing the regulatory improvement recommendations offered in the Oct. 18 hearing is key to make Artemis successful.

Rocket Reusability

Question 1. Rocket reusability allows SpaceX to repeatedly fly the most expensive parts of its rocket by driving down the cost of space and paving the way for new entrants to follow the SpaceX model. For instance, SpaceX’s Falcon 9 is the world’s first orbital, reusable two-stage rocket designed and built for safe transport of people and payloads into Earth orbit and beyond.

a. Does SpaceX’s rocket reusability factor into the reliability of the rocket for licensing purposes? That is, does a flight proven system have an easier time getting cleared quickly for launch? If not, should it?

Answer. Yes. Reusing rockets and high flight rates significantly enhance vehicle reliability for many reasons, and AST should establish an expedited licensing pathway for mature vehicle systems with a proven flight history. Such a pathway does

not exist today. The key to reliable reusability is examining the flown hardware and learning about life-sensitive components. An initial test program to understand projected life is also important. The post-flight monitoring confirms the reusable design is operating as designed. The FAA current regulations do not handle reuse well and do not recognize the advantages of a well-executed reuse approach.

FAA Launch and Licensing

Question 1. In your written statement, you said AST needs to at least double the resources of FAA's AST to meet the growing workload. What are SpaceX's views on requiring launch providers to 'pay into the system,' similar to the way in which the Airport and Airway Trust Fund works, to help pay for this growth?

Answer. SpaceX recommends that Congress establish new authority for FAA to allow applicants to pay for external technical reviewers to ensure license reviews are completed in a timely fashion when the FAA lacks internal technical capabilities. Ensuring timely and appropriate review is important. More resources with no emphasis on timeliness would not be helpful.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. J. D. VANCE TO
WILLIAM H. GERSTENMAIER

Proprietary Data and Intellectual Property

Reluctance to share data has been flagged in several reports as a barrier to standards development and the implementation of voluntary safety systems. These reports point to a variety of solutions, including statutory data protection, programs to facilitate sharing proprietary data, and memorandums of understanding (MOUs) between the Federal Aviation Administration (FAA) and individual companies.

I understand this reluctance to share data. These reports indicate that companies are concerned that any shared data could be traced back to the company due to the small number of providers and the significant differences between their vehicles. Companies view the protection of their data as important for their commercial competitiveness.

Question 1. While commercial companies need to protect their proprietary information, data-sharing between commercial providers will be vital for standards development, collaborative research, and voluntary safety systems. What protections could be implemented to facilitate data-sharing between companies while protecting proprietary data and intellectual property? Would legislation best address this issue, or could agency-led or industry-led measures be effective?

Answer. FAA should continue to facilitate the development and evaluation of voluntary industry consensus standards/guidelines. The Department of Transportation has convened the Part 460 Space Aerospace Rulemaking Committee (SpARC) to review the broader commercial human spaceflight safety framework. One of the topics of discussion both there and within the Commercial Space Transportation Advisory Committee (COMSTAC) is the facilitation of non-proprietary data sharing between companies to enhance safety. The Part 460 SpARC aims to complete its review by late 2025.

Question 2. How can Congress and the FAA encourage collaboration between industry while protecting proprietary data?

Answer. Congress and the FAA should support the development of voluntary industry consensus standards, including for data sharing, and efforts of the Part 460 SpARC in determining opportunities for non-proprietary data sharing to enhance safety. It is also important to note that much information related to launch and re-entry systems is export controlled under the International Trafficking in Arms Regulations (ITAR), which must be considered when evaluating the release and sharing of information.

Ohio's Space Capabilities

Ohio is the birthplace of aviation and has a rich tradition of excellence in aerospace. It started with the Wright Brothers, continued with Neil Armstrong and John Glenn, and lives on today with so many people, companies, and universities on the cutting-edge of innovation.

Following in this tradition, Ohio is home to world-class spaceflight testing capabilities not available anywhere else on the globe. But I hear they are often underutilized by commercial partners or even non-NASA Federal partners.

Question 1. Can you update us on testing done by SpaceX at the Neil Armstrong Testing Facility in Sandusky, for example rocket fairing separation tests done in the large vacuum chamber there, and how these tests in Ohio are helping you accomplish your various commercial space projects?

Answer. SpaceX has maintained a long and fruitful partnership with NASA Glenn Research Center (GRC) and the Neil Armstrong Testing Facility. SpaceX recently conducted payload fairing testing within the Space Environments Complex, and has performed similar testing on other occasions over the last decade. SpaceX also tested the Crew Dragon vehicle—which provides all of NASA’s orbital human spaceflight access today—within the In-Space Propulsion Facility at Armstrong, and Starlink satellites, which provide high-speed, low-latency broadband across Ohio and around the world. The unique facilities and expertise offered by NASA in Ohio have been vital to space vehicle development and testing at SpaceX and across the industry.

SpaceX also continues to maintain a strong programmatic partnership with GRC in support of the Artemis Human Landing System (HLS) Program to return Americans to the Moon and in support of the Communications Services Project (CSP) to provide high-speed, low-latency commercial data to NASA spacecraft.

Question 2. What could space centers in Ohio—specifically the Neil Armstrong Testing Facility in Sandusky, NASA Glenn in Cleveland, or Space Force assets at Wright-Patterson Airforce Base do better, to further support commercial spaceflight, for example through more testing of hardware? Is this a matter of cost for SpaceX or is there some other reason? How can we better promote the utilization of these key National resources? NASA/Glenn Research Center in Cleveland has the Agency’s lead assignment for future space communication. How best should NASA/Glenn work with the rest of the Federal Government as part of its leadership role in this area, to help fortify commercial space-flight in areas from spectrum licensing to technology advancement, and does NASA/Glenn have the resources it needs to accomplish this role?

Answer. SpaceX is proud to maintain a strong partnership with NASA GRC for the Communications Services Project and the Human Landing System Program. Each program will continue for many years.

Much of the hardware testing that is performed within the vacuum facilities at GRC tends to be one-off qualification testing, rather than recurring work between missions. SpaceX intends to continue to partner with GRC and Armstrong for future vehicle testing.

Question 3. On October 16, UC Berkeley announced participation in a new \$2B space research park at NASA/Ames in California. In my home State of Ohio, Voyager/Airbus have announced the establishment of the George Washington Carver Science Park on the campus of The Ohio State University, as an integral part of their efforts on *Starlab*, one of NASA’s commercial low-Earth orbit destination replacements for the ISS after 2030. What key roles do you see Universities—especially public Universities—playing, in order to maximize the potential success of commercial spaceflight in low-Earth orbit and beyond?

Answer. Universities are key to stimulating direct science and low-cost technology demonstrators, and in cultivating the next generation of skilled engineers to support continued American leadership in space. With SpaceX’s reusable Falcon vehicle systems significantly reducing the cost of space access, universities are now far more able to launch small satellites into orbit—proving out new technologies and providing vital technical training to engineering students.

On-Orbit Authority

Question 1. To what extent does the lack of regulatory authority for on-orbit activities affect the commercial human spaceflight industry, if at all?

Answer. The present regulatory regime is sufficient for commercial human spaceflight.

Question 2. As the industry prepares for commercial space stations, should a Federal agency be given on-orbit authority that addresses commercial human spaceflight? If so, which agency should be tasked with this authority and why?

Answer. The Department of Commerce is the most appropriate authority to oversee any light-touch, presumed-approach mission authorization regime that protects national security and ensures treaty compliance.

Question 3. In discussions regarding on-orbit authority or mission authorization, many disagree on whether Commerce or FAA should have this authority. How does commercial human spaceflight factor into these discussions?

Answer. Human spaceflight should not be considered in a mission authorization framework. The goal of any such framework should be to protect public safety, ensure treaty compliance, and further national security. Neither the Department of Commerce nor FAA have the technical expertise or the resources to contemplate on-orbit commercial human spaceflight. Developing regulations early-to-need would inhibit continued development of American human spaceflight systems and national competitiveness.

Miscellaneous

Question 1. As humans look to operate on orbit and beyond can you speak to lessons learned from commercial launch and how the U.S. government should approach working with commercial companies operating human activities in space moving forward?

Answer. The United States Government has derived tremendous value from its partnerships with the commercial launch and reentry industry. As has been noted by NASA, the Space Force, the Government Accountability Office (GAO), and the NASA Office of the Inspector General (OIG), the Government has saved billions of dollars through these partnerships, while unlocking new capabilities like the Falcon 9, Falcon Heavy, Dragon, and Starship that are furthering American leadership in space. The U.S. Government should continue to maximize firm, fixed-price contracting for commercial launch services and focus any internal development efforts on areas with limited or no commercial value (*e.g.*, probes to distant planets, etc.).

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARIA CANTWELL TO
PHIL JOYCE

Human Spaceflight Occupant Safety

We are entering a golden age for commercial spaceflight. As we see the sharp increase in space launches and witness the first of many fully civilian spaceflights, the safety of those onboard must be a top priority, just as public safety is. In just over a year, we have experienced two significant mishaps with launch vehicles intended for human spaceflight. On September 12, 2022, the Blue Origin New Shepard suborbital rocket suffered a failure a little more than a minute after launch, resulting in the vehicle's emergency abort system jettisoning the capsule away from the booster. On April 20, 2023, SpaceX's first attempt to launch Starship resulted in the catastrophic loss of the vehicle and damage to the launch pad that sent debris as far as five miles from the Boca Chica, Texas launch site.

Question 1. If humans had been aboard these missions, what safety measures would have prevented loss of life?

Answer. New Shepard is designed to rapidly remove astronauts from a hazardous booster condition via our highly redundant and fault-tolerant Crew Capsule (CC) escape system. On the flight referenced in the question, the escape system functioned as designed throughout the flight, successfully propelling the CC away from the booster to safety. The capsule and all payloads onboard landed safely and will be flown again. Blue Origin's NS-23 telemetry data shows the astronauts would have experienced no more than the expected dynamic forces for a capsule escape event and likely would not have been injured. This unplanned and successful test of New Shepard's safety architecture in addition to three prior successful escape tests confirms that Blue Origin's top priority is the safety of those on board.

Question 2. Do your companies have a process for reviewing critical human-safety systems onboard vehicles that have successfully completed commercial human flights to ensure they worked properly?

Answer. Yes. Safety assurance is built into every phase of our operation.

FAA's Needs for Commercial Regulation

It is clear that the Federal government must prepare to regulate the commercial human spaceflight industry. This means ensuring our agencies are well staffed, knowledgeable, and ready to regulate. We have heard from stakeholders that the FAA does not have personnel or at least not enough personnel with the right skill sets to begin regulating commercial human spaceflight occupant safety on January 1, 2024.

Question 1. Given your experience with FAA/AST from the commercial side, what do you believe FAA needs to do to ensure the safe transportation of humans into, through, and back from space?

Answer. The most impactful actions that FAA can take are those that improve the administration of the current set of regulations for launch and reentry. Demonstrating the ability to scale the existing framework will yield lessons learned that will be critical for any future requirements related to occupant safety. To achieve this scale, AST will require a laser focus on efficiency in the utilization of their resources.

An example of an opportunity for streamlining is the duplication of detailed analysis for flight safety even after validation of procedures. Subject matter experts spend time recreating every analysis despite a robust approval process for all meth-

ods & tools used. This is unnecessary and time-intensive for personnel whose time could be better used evaluating other complex processes.

Efficiency gains may also be found by focusing on the development of tools and trainings that support a limited workforce. Significant recent efforts in recruiting and university engagement by the FAA have been helpful in driving new talent to the agency. Blue Origin has recommended developing a training curriculum so that lessons learned throughout the application review are more easily transferred to all employees. Blue Origin also recommends building tools to support project management of license applications, tracking inputs, comments, and results.

Washington Space Workforce

The launches that we've seen from the companies here today would not have been possible without the engineers, mechanics, and technicians who made these systems possible. My home state of Washington is a prime example of the aerospace and space ecosystem. Our space industry supports more than 13,000 workers, with an economic impact of \$4.6 billion annually. About 5,000 of those workers work at Blue Origin, and more than 1,300 work at SpaceX, creating Starlink satellites. As we move forward in the rapidly changing field of commercial space, we know that these numbers will only grow. It is key that we ensure we have the domestic workforce to keep up with that growth. We're seeing shortages across the STEM fields, with a 60,000-workforce shortage in Washington alone by 2026. Ensuring we have a strong domestic space workforce is key to remaining internationally competitive.

Question 1. What workforce needs and challenges do you see for the commercial space industry?

Answer. Blue Origin's mission is to build a road to space for the benefit of Earth. Achieving our goals will require a sustained pipeline of talent to all our sites, including our headquarters in Kent, WA. Blue Origin is working to overcome challenges in developing a diverse, steady pipeline.

One area of concern is the limited volume of the skilled technician workforce required to support manufacturing and assembly of our products, including sub-orbital and orbital rockets, rocket engines, lunar landers, and in-space systems. Among other roles, Blue is especially challenged to hire skilled machinists and welders. We are working to pair concentrated recruiting efforts with an expansion of our relationships to the sources of these pipelines: community colleges, trade schools, and apprenticeship programs.

Another challenge is growing the level of diversity in all areas of our workforce, especially technical roles. Blue is working diligently to hire and retain diverse talent. We have made strides in improving our early career pipeline by engaging directly with universities and minority organizations like the Society of Women Engineers and National Society of Black Engineers, but continued work is needed to secure the same success in the mid-and late-career populations.

A growing industry needs a growing workforce, and we are challenged to increase awareness of the space industry as a career path that is desirable and rewarding. Blue Origin's Club for the Future nonprofit targets K-12 students to inspire the next generation to pursue careers in STEM and help invent the future of space. Over 20,000 students in WA have been reached by this program, but investment in continued engagement of students throughout their educational career continues to be critically important for the future of the space workforce.

Commercial Human Spaceflight Learning Period

While I am a strong proponent of rapid innovation and competition, safety is my top priority. The FAA has the authority to regulate commercial human spaceflight, but Congress instituted a statutory "learning period" that limits the agency's regulatory authority. The learning period for commercial human spaceflight was intended to promote rapid innovation in a nascent industry with few players. And Congress has seen fit to extend this "learning period" three times—in 2012, 2015, and most recently, the latest Continuing Resolution. The learning period will end on January 1st, 2024. Since the 2015 learning period extension, Virgin Galactic and Washington's Blue Origin have carried out successful sub-orbital civilian human spaceflights. And so far, there has only been one purely commercial orbital civilian human spaceflight, SpaceX Inspiration 4—but this is expected to change according to the testimony we have heard today. As we've seen from the rapidly increasing cadence in flights and in testimony today, the commercial space industry is poised to go far beyond the industry we saw in past learning period extensions.

Question 1. Can you explain what your company still needs to learn about keeping your spaceflight participants safe? [original questions separated below for ease of response]

Answer. Increased flight experience allows us to continuously improve. As we fly more, our flight results can inform product updates that enhance our safety performance, and the current model allows us to rapidly introduce these improvements to achieve safer systems faster. This process is what makes any industry competitive and ensures a market for human spaceflight activities remains viable. To date, only 14 commercial launches have carried paying civilian space flight participants. The industry needs to continue to innovate and upgrade to achieve a sustained commercial human spaceflight cadence that can open access to space for more, and more diverse, astronauts. The existing crew regulations found in Part 460 and the informed consent requirements for space flight participants ensure that the public is not at increased risk due to these activities, and customers are robustly informed of the risks associated with their mission.

An extended learning period would benefit the FAA. We are also looking at the volume of uncrewed launch licenses being processed by the FAA and believe that the Office of Commercial Space Transportation (AST) needs to learn how to streamline those operations before adding additional responsibilities. The resources, tools, and training that AST needs to keep pace with industry today are important inputs to building new safety framework in the future.

How much longer do you believe the current learning period should be extended beyond January 1, 2024?

Answer. The Commercial Spaceflight Federation has advocated for 8 years. This is a reasonable timeline to expect to see the continued innovation & improvements enabled by the current regulatory environment. Congress can and should continue to monitor progress within the industry and within the FAA and encourage communication between the two.

Can you then focus on maintaining the safety of humans working and living on-orbit or even on the surface of the moon or Mars?

Answer. These efforts are not sequential, and we will apply lessons learned and best practices across all our products and programs including those on-orbit, lunar, and beyond.

Can NASA's experience be immediately applied to defining appropriate safety standards and regulations?

Answer. NASA's human spaceflight experience and associated documentation are valuable inputs that our programs have leveraged to build our safety systems and processes, but those do not represent a single solution to safety. It is important to evaluate all data sources based on applicability to the mission and architectures being developed. It is also equally important to consider lessons learned from other safety-critical industries to continually expand our understanding and improve best practices.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. KYRSTEN SINEMA TO
PHIL JOYCE

Mission Authorization

I am excited that Blue Origin has partnered with Arizona State University on the Orbital Reef commercial space station project. This project seems to epitomize "novel" space activities—all the potential applications of a space station with attachable modules cannot possibly be known. The ability for private companies to train non-government astronauts and conduct commercial operations in low Earth orbit is a true game changer.

Of course, under current law there is no defined regulator with such a new "mission authorization" authority.

Question 1. As Congress works to clarify agency authority and remove uncertainty over novel space activities, what are the critical components to create a workable, efficient, and safe regulation?

Answer. The following are critical components to a workable system of authorization and supervision:

- defining a clear, single agency responsible for new and novel activities;
- publishing a transparent, focused set of requirements for approval;
- providing defined timelines for review; and
- minimizing overlap or duplication between mission authorization and the existing licensing regimes.

From this foundation, the commercial space industry and its Federal regulation can evolve over time as the need arises for new oversight mechanisms to maintain U.S. leadership in space.

NASA Partnerships

The NASA Commercial Crew program has used commercial services to launch astronauts to the International Space Station since 2020. The Suborbital Crew or SubC program leverages commercial companies to send NASA personnel to space using a “system qualification” system rather than formal certification process.

Question 1. How do innovations like the SubC program further efficiency for both private and government entities? How can we learn from programs like this and scale them up as the commercial sector expands?

Answer. Innovations like the SubC program allow NASA to benefit from, rather than compete with, the robust domestic commercial space industry that gives the United States an advantage relative to global competitors. NASA should continue to embrace the commercial space industry by taking advantage of existing capabilities like commercial suborbital launch vehicles through Suborbital Crew while also utilizing public-private partnerships to develop new capabilities like the Commercial Crew & Cargo program and the Human Landing System program.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN HICKENLOOPER TO
PHIL JOYCE

Commercial Low-Earth Orbit (LEO) Destinations

Colorado aerospace companies have been at the forefront of designing commercial space stations of the future. Currently, NASA’s Federal research takes place at the International Space Station (ISS), which will be retired later this decade.

Question. In the near-future, how are commercially-operated space stations going to host Federal research experiments that used to be done on the ISS?

Answer. NASA is working with U.S. companies to develop designs of commercially operated space stations through NASA’s Commercial Low Earth Orbit (LEO) Development Program. Per NASA’s ISS Transition plan, these companies are developing commercial LEO destinations (CLDs) to begin operations in the late 2020s to ensure operational overlap with the ISS before its retirement. This will facilitate the transition of new and existing Federal research experiments from ISS to operational CLD capacity.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TED CRUZ TO
PHIL JOYCE

ISS Extension/Commercial LEO

Ensuring the U.S. maintains a presence in low Earth orbit (LEO) after the eventual decommissioning of the International Space Station (ISS) is a priority of mine. It is vital for both America’s national security and for the next generation of exploration and science missions.

Question 1. As one of the early participants in the Commercial LEO Development (CLD) program, what is the prognosis for getting a commercial space station in orbit by 2030?

Answer. It will be a challenge to have a commercial space station in orbit by 2030 with the funding levels forecasted for the CLD program in NASA’s FY24 budget request. Increased outyear funding for the CLD program would increase the likelihood that NASA is able to execute its ISS Transition Plan.

Question 2. How can industry and the National Aeronautics and Space Administration collaborate to leverage the expertise of the existing workforce, such as those involved in ISS mission support, to help speed up the CLD program?

Answer. Blue Origin’s Orbital Reef team has benefited greatly from leveraging NASA expertise under Phase 1 of Commercial LEO Destinations, for example conducting technology demonstrations of new materials onboard the ISS. It will be essential that under Phase 2 of the program NASA continues to provide opportunities that align with its next phase vision for commercial LEO.

Question 3. Do you believe there is enough of a truly commercial market to support more than one commercial space station?

Answer. NASA will be an essential anchor tenant for the commercial space station that replaces ISS after ISS retirement. We do not believe there is sufficient commer-

cial demand to support more than one commercial space station in the years immediately following ISS retirement.

Question 4. What are the biggest challenges you are facing in meeting the 2030 goal?

Answer. The outyear funding levels forecasted for the CLD program in NASA's FY24 budget request and the level of regulatory certainty for operating a commercial space station are both insufficient to ensure a commercial space station is in orbit by 2030.

a. Do you believe the 2030 date is achievable?

Answer. Yes, with effective collaboration and partnership between NASA and industry and sufficient policy and funding support from Congress, the 2030 date is achievable.

Question 5. In your opinion, what is the best way for the United States to ensure there is no gap between the ISS and whatever the follow-on capability is in LEO?

Answer. The United States must take a whole of government approach to provide the policy, funding, and regulatory certainty required to meet NASA's ISS Transition Plan and avoid a gap between the ISS and a United States-led follow-on capability in LEO. NASA and industry must work together to ensure that our international partners utilize a U.S.-led space station post ISS.

FAA Launch and Licensing

Question 1. At the October 18th hearing, Mr. Gerstenmaier of SpaceX discussed the need for substantially increasing resources at the Federal Aviation Administration (FAA), advocating for at least doubling the resources of FAA's Office of Commercial Space Transportation (AST) to meet the growing workload. As a commercial launch company working to certify launch vehicles and obtain licenses for launch and reentry from FAA AST, what are Blue Origin's views on requiring launch providers to 'pay into the system,' similar to the way in which airlines pay into the Airport and Airway Trust Fund, to help pay for this growth?

Answer. Commercial aviation is heavily reliant on shared services as an industry, from exhaustive airport infrastructure to air traffic control that supports over 16 million flights per year, 24 hours a day. In stark contrast, the commercial space industry has invested heavily in its own launch site infrastructure without FAA support and the 106 licensed launches in FY23 each transited the airspace for only minutes at a time. Commercial launch licensing also supports launches where the government itself is a customer. Implementing significant fee structures could cripple the industry and pass costs back to the United States itself.

AST Operations represents 0.16 percent of the requested FAA budget in FY24, but the relative size of AST funding does not imply that resources should be provided in an unbounded or unmeasured way. Increased resources should be paired with accountability mechanisms to ensure that Federal investment is being used to improve its capabilities in supporting its public safety mandate and continued industry growth.

Question 2. In your estimation, are resource constraints at FAA AST the biggest challenge for industry in terms of licensing for commercial space activities?

Answer. Resources are a big challenge for FAA AST, but resources should be paired with increased focus on using personnel more efficiently and identifying ways to train and retain its workforce. Resource increases and other process improvements should be evaluated regularly against metrics that demonstrate increasing cadence of review throughout the lifecycle of an application.

An example of an opportunity for streamlining is the duplication of detailed analysis for flight safety even after validation of procedures. Subject matter experts spend time recreating every analysis despite a robust approval process for all methods & tools used. This is unnecessary and time-intensive for personnel whose time could be better used evaluating other complex processes.

Commercial Manned Spaceflight Moratorium and Regulation

Question 1. One of your fellow witnesses, Brig. Gen. Wayne Monteith of National Aerospace Solutions who was also the last head of the FAA AST, suggested a two-phase approach to the regulation of human spaceflight. Phase 1 would be setting a date before which FAA may not publish new regulations but is allowed to start working on them during that period, and phase 2 would include setting an effective date for those regulations, which would occur a number of years after the regulations are published. This gap between the publishing of final regulations and their becoming effective would provide a fail-safe, allowing Congress to intervene in case industry was still not mature enough for the new regulations. In his view, a forcing

function is necessary to keep industry and regulators working toward consensus rules.

a. What does Blue Origin think of this proposal?

Answer. The activities for which Brig. Gen. Monteith is advocating are all possible and encouraged under the learning period as it is defined today. The visibility gained through the launch and reentry licensing process and participation in industry standard forums are substantial avenues for regulator learning. We would encourage the FAA to continue to evaluate these efforts and seek feedback from operators during an extended learning period. The active Part 460 Aerospace Rulemaking Committee (SpARC) is a good example of industry and the regulator's mutual commitment to moving the conversation forward.

Question 2. In the long term, do you think FAA is the best home for the regulation of commercial spaceflight, or should Congress consider standing up a new, independent entity?

Answer. The Office of Commercial Space Transportation (AST) should remain solely focused on its role in licensing launch and reentry operations in service of public safety and safety of property. This focus could be better supported by positioning AST under the Secretary of Transportation rather than embedded in the FAA, where the critical distinction from commercial aviation is more difficult to operationalize.

National Security

Question 1. Blue Origin's New Glenn rocket has been under development for a number of years. In November 2022, U.S. Space Systems Command and Blue Origin signed a cooperative research and development agreement, which Brig. Gen. Stephen Purdy said "marks the restart of certification activities for Blue Origin's New Glenn that began in 2018 when Blue Origin won a Launch Service Agreement."¹ New Glenn will potentially provide a third launch option for the National Security Space Launch (NSSL) program, which will be incredibly important for providing guaranteed access to space.

a. What hurdles remain for New Glenn development and when does Blue Origin expect New Glenn to launch?

Answer. Blue Origin's New Glenn rocket is a reusable workhorse purpose-built to deliver high volume and mass to orbit. Its simple design—and game-changing seven-meter fairing—continue to make steady advancement along our pre-planned development path toward a first launch in 2024. We are proud that of the progress we have made thus far, including a successful Hardware-in-the-loop (HIL) flight, BE-4 engine development and qualification testing, booster and second stage qualification testing, payload fairing jettison testing, and successful tests of our transport erector. We remain on path to achieve National Security Space Launch (NSSL) certification and, if selected, we look forward to supporting Phase 3 of the NSSL Program.

Question 2. Of the hurdles that remain for New Glenn, how many of them are regulatory in nature and how can those be sped up or addressed?

Answer. Blue Origin is committed to building a strong partnership with the FAA Office of Commercial Space Transportation (AST) and is proceeding through our New Glenn license application to ensure that regulatory framework supports our ability to launch.

FAA statements and actions indicate that the FAA has not been provided the resources needed to succeed in their mission. License application reviews are taking longer than the statutory 180-day review time and application tolling is becoming more common than in the previous decade. Application document reviews get delayed because the task-saturated FAA subject matter experts are tied up supporting the evaluations of other applications—sometimes causing a month or more delay.

Despite having regulations that are meant to govern all forms of vehicles from suborbital space planes to orbital rockets, it too frequently appears that the means of compliance may curtail innovation—with FAA looking for the same material from one operator to the next. This creates a challenging prospect for operators—no matter how you plan to ensure public safety, through historical or novel methods, you need to mold it into the format the FAA wants to see, creating additional and superfluous work for operators. If given the appropriate resources discussed in the pre-

¹ Wolfe, Frank. "US Space Force Signs CRADA with Blue Origin to Restart Certification of New Glenn Rocket." *Via Satellite*. (November 22, 2022). <https://www.satellitetoday.com/government-military/2022/11/22/us-space-force-signs-crada-with-blue-origin-to-restart-certification-of-new-glenn-rocket/>

vious question, AST may be able to address novel means of compliance more efficiently both to ensure public safety and U.S. national security interests.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. J. D. VANCE TO
PHIL JOYCE

Proprietary Data and Intellectual Property

Reluctance to share data has been flagged in several reports as a barrier to standards development and the implementation of voluntary safety systems. These reports point to a variety of solutions, including statutory data protection, programs to facilitate sharing proprietary data, and memorandums of understanding (MOUs) between the Federal Aviation Administration (FAA) and individual companies.

I understand this reluctance to share data. These reports indicate that companies are concerned that any shared data could be traced back to the company due to the small number of providers and the significant differences between their vehicles. Companies view the protection of their data as important for their commercial competitiveness.

Question 1. While commercial companies need to protect their proprietary information, data-sharing between commercial providers will be vital for standards development, collaborative research, and voluntary safety systems. What protections could be implemented to facilitate data-sharing between companies while protecting proprietary data and intellectual property? Would legislation best address this issue, or could agency-led or industry-led measures be effective?

Answer. The commercial space industry features a broad range of architectures and mission profiles, leading to unique designs and operations, particularly for human spaceflight activities. The amount of data generated by the small number of operators has been limited, and primarily useful for validating proprietary design features under nominal conditions. This data is generally less useful for architectures that do not utilize the same systems and is unlikely to lead to broad industry findings.

The FAA maintains visibility to all operations, including human spaceflight activities, through the licensing process. This unique viewpoint can allow them to observe safety-related patterns between operators. Where significant commonality is observed, the FAA may encourage prioritization of certain standards or research so that any potential data-sharing is impactful. They should also leverage industry data to validate and improve existing analysis processes used for launch license approvals today.

Question 2. How can Congress and the FAA encourage collaboration between industry while protecting proprietary data?

Answer. As noted in the previous answer, the FAA does have broad visibility of industry designs and processes. They have a role to play in ensuring that safety conversations are prioritized appropriately to topics that have industry-wide impacts and represent real lessons learned from licensing operations. Their participation in industry standards efforts could be strengthened by understanding this potential role.

Ohio's Space Capabilities

Ohio is the birthplace of aviation and has a rich tradition of excellence in aerospace. It started with the Wright Brothers, continued with Neil Armstrong and John Glenn, and lives on today with so many people, companies, and universities on the cutting-edge of innovation.

Following in this tradition, Ohio is home to world-class spaceflight testing capabilities not available anywhere else on the globe. But I hear they are often underutilized by commercial partners or even non-NASA Federal partners.

Question 1. NASA/Glenn Research Center in Cleveland has the Agency's lead assignment for future space communication. How best should NASA/Glenn work with the rest of the Federal Government as part of its leadership role in this area, to help fortify commercial space-flight in areas from spectrum licensing to technology advancement, and does NASA/Glenn have the resources it needs to accomplish this role?

Answer. NASA Glenn Research Center plays a critical role in advancing technologies across multiple Blue Origin programs. For example, Blue Origin recently conducted rocket fairing jettison testing for our New Glenn orbital launch vehicle in the largest thermal vacuum chamber in the world at NASA Glenn's Armstrong Test facility. We also have a substantial scope of work planned with NASA Glenn in support of the Blue Origin-led National Team's crewed lunar lander for the

Artemis Human Landing System program. Additionally, Glenn's space communication capabilities offer an exciting future for networking in-space, one where utilization of Blue Origin's Blue Ring spacecraft can help establish an internet-like network throughout space. It is essential that NASA maintain its critical resources at NASA Glenn.

Question 2. On October 16, UC Berkeley announced participation in a new \$2B space research park at NASA/Ames in California. In my home State of Ohio, Voyager/Airbus have announced the establishment of the George Washington Carver Science Park on the campus of The Ohio State University, as an integral part of their efforts on *Starlab*, one of NASA's commercial low-Earth orbit destination replacements for the ISS after 2030. What key roles do you see Universities—especially public Universities—playing, in order to maximize the potential success of commercial spaceflight in low-Earth orbit and beyond?

Answer. Universities play a key role in building the workforce needed to support commercial spaceflight in LEO and beyond. Universities must be supported in building deeper partnerships with industry, to ensure students gain the specialized knowledge required to succeed in our unique industry. Supporting priority research areas, technical student competitions and providing opportunities for internships can help industry leverage the enthusiastic and diverse talent found in universities across the US. Aligning with our commitment to the Space Workforce 2030 pledge, Blue Origin offers internships in the Spring, Summer, and Fall to maximize our ability to expose young talent to the industry. This year we hosted 129 summer interns, each given substantive work and mentorship.

Programs like this generate both experienced young talent and ambassadors for the space workforce within their universities.

On-Orbit Authority

Question 1. To what extent does the lack of regulatory authority for on-orbit activities affect the commercial human spaceflight industry, if at all?

Answer. As we develop platforms like our Orbital Reef commercial space station in support of NASA's CLD program, it is important to understand how authorization and supervision of activities that may take place on board will be carried out in the U.S. government. The lack of clarity around these novel activities makes it difficult to identify stakeholders that might benefit from awareness of our intended programs prior to application. This has also led to debates about whether the U.S. is fulfilling treaty obligations as compared to other countries. This uncertainty has led to legal questions within the investor and customer communities that would benefit from clear authority.

Question 2. As the industry prepares for commercial space stations, should a Federal agency be given on-orbit authority that addresses commercial human spaceflight? If so, which agency should be tasked with this authority and why?

Answer. Authorization of novel space activities is required to meet our international treaty obligations and any authorization regime should have a single government owner. The range of potential activities is wide, so every effort should be taken to eliminate duplicative requirements, limit unstructured interagency processes, and draw clear boundaries between agencies with related authorities. While available expertise should be mined from other stakeholders in the government, the Department of Commerce would be an appropriate entity to carry out these authorizations.

Question 3. In discussions regarding on-orbit authority or mission authorization, many disagree on whether Commerce or FAA should have this authority. How does commercial human spaceflight factor into these discussions?

Answer. The broad range of human-centric in-space activity should be categorized and regulated as commerce. The Department of Commerce remains the appropriate owner for these activities. As discussed in the question above, like other novel activities, it is likely Commerce will need to be capable of seeking stakeholder inputs for these activities without leading to unbounded interagency processes.

Miscellaneous

Question 1. As humans look to operate on orbit and beyond can you speak to lessons learned from commercial launch and how the U.S. government should approach working with commercial companies operating human activities in space moving forward?

Answer. The launch licensing framework offers good lessons for any regulatory regime:

- Regulate only to the extent necessary—the goals of a regulatory regime should be clearly stated. The public safety focus of the FAA's launch licensing process

is used to draw boundaries around what is required in an application. The U.S. government will need to approach novel on-orbit activities with a light touch for some time, until it is clear additional steps are necessary.

- Regulations should be streamlined and flexible to novel approaches—Driving specific means of compliance into regulatory text limits innovation and improvement in a complex environment. A minimal set of performance or process-based regulations should be prioritized only if necessary to achieve the clearly authorized goals.
- Communicate with industry—companies pursuing on-orbit activities are building a robust pipeline of talent and experience that should be leveraged by the U.S. government rather than expecting to be an independent, disconnected source of expertise. Commitment to building these relationships is critically important.
- Rulemakings should consider industry feedback without an expectation of full consensus—the most recent Part 450 rulemaking convened a diverse set of operators to provide feedback in a short window via a Rulemaking Committee. Some of this critical feedback was unable to achieve 100 percent consensus through this process and was ignored in the drafting of rules. This process cannot be repeated in diverse industries.

