

STARSHIPS AND STRIPES FOREVER—AN EXAMINATION OF THE FAA'S ROLE IN THE FUTURE OF SPACEFLIGHT

(117-19)

REMOTE HEARING
BEFORE THE
SUBCOMMITTEE ON
AVIATION
OF THE
COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES
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JUNE 14, 2021

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Staff, Subcommittee on Aviation
RE: Subcommittee Hearing on “Starships and Stripes Forever—An Examination of the FAA’s Role in the Future of Spaceflight”

PURPOSE

The Subcommittee on Aviation will meet on Wednesday, June 16, 2021, at 2:00 p.m. EDT in Room 2167 of the Rayburn House Office Building and virtually via Zoom for a hearing titled, “Starships and Stripes Forever—An Examination of the FAA’s Role in the Future of Spaceflight.” The hearing will explore broadly the future of the U.S. commercial space transportation industry, its rapid growth and expansion into human spaceflight, and the role of the Federal Aviation Administration (FAA) in overseeing and regulating the industry. The Subcommittee will receive testimony from representatives of the FAA, the Government Accountability Office (GAO), United Launch Alliance, Space Florida, Air Line Pilots Association, and Virgin Galactic. The FAA and GAO witnesses will testify on the first panel, and the other witnesses on the second panel.

I. BACKGROUND

Commercial space transportation—through the use of orbital and suborbital vehicles manufactured, owned, or operated by private companies or other non-federal organizations—transports objects such as satellites, scientific payloads, other cargo, and passengers (referred to as spaceflight participants) to, from, and throughout space.¹ In 2018, when the FAA’s most recent annual commercial space compendium was published, the size of the global space economy—private industry revenues and government budgets—was estimated to be about \$345 billion.² In 2016, the size of the U.S. space industry alone was approximately \$158 billion, which included more than \$110 billion in revenues generated by satellite services, manufacturing, ground equipment, and launch services, and approximately \$48 billion spent by the U.S. Government on space programs.³

Commercial space transportation services help fulfill many government needs, including supplying the International Space Station, deploying classified military and

¹ GAO, *Commercial Space Transportation: FAA Should Examine a Range of Options to Support U.S. Launch Infrastructure*, GAO-21-154 at 4 (Dec. 2020).

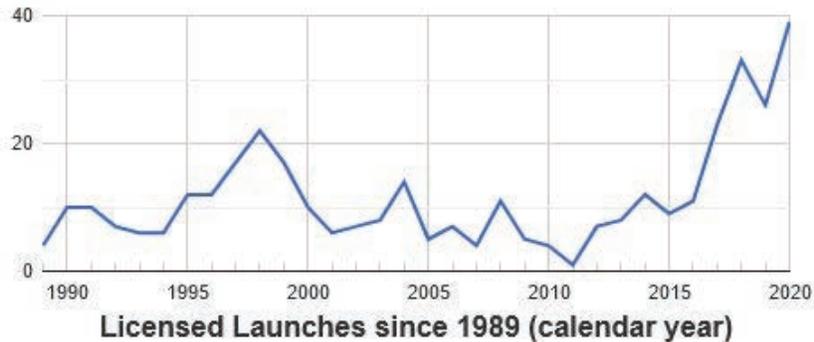
² FAA, *The Annual Compendium of Commercial Space Transportation: 2018* at 9–10 (Feb. 2018), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2018_AST_Compendium.pdf.

³ FAA, *The Annual Compendium of Commercial Space Transportation: 2018* at 9–10 (Feb. 2018), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/2018_AST_Compendium.pdf.

intelligence payloads, and supporting reconnaissance and communications capabilities.⁴ The commercial launch of satellites broadly benefits society by providing a wide range of modern services, from television and radio broadcast to high-speed Internet and weather information, through the use of communications and remote sensing satellites.⁵ Moreover, the commercial launch technology is ever evolving; several private companies, most notably SpaceX, have developed reusable launch vehicles capable of being launched multiple times into space.⁶ This and other advances promise to bring down the cost of building and launching rockets, thereby reducing barriers to the expansion of commercial activity in space.

II. INDUSTRY GROWTH

The FAA has indicated that the industry has grown steadily over the last decade. In total, there have been 403 licensed commercial space launches since the first launch in 1989, with nearly one half of those occurring in the last ten years alone, as depicted in the table below.⁷ This includes a record 39 licensed launches taking place just in the last year.⁸



This trend is expected to continue as the FAA already has 46 licensed launches scheduled for this fiscal year.⁹ This amounts to a nearly 400 percent increase in FAA launch licenses between 2015 and 2020.

From fiscal year 2016 through fiscal year 2021, the FAA's commercial space transportation operating budget and staffing levels have grown, from \$17.8 million and 84 full-time equivalents (FTEs) to \$27.5 million and 117 FTEs.¹⁰ The FAA has also adopted or plans to adopt numerous measures to maximize its use of existing resources, including reorganizing lines of business within its commercial space transportation office, hiring more personnel, streamlining regulations and processes, transitioning from a physical to an online application system, and developing and incorporating newer, more efficient technologies.¹¹ The President's fiscal year 2022 budget request includes an increase of funding and staffing levels to \$32.47 million and 108 FTEs, although this amount falls below the \$64.5 million authorized for the

⁴ Morin, Wilson, *Space Agenda 2021—Leveraging Commercial Space for National Security*, Aerospace Corporation—Ctr. for Space and Pol. Strategy (Nov. 2020), https://aerospace.org/sites/default/files/2020-11/Morin-Wilson_Leveraging_20201113.pdf.

⁵ FAA, *Space—Frequently Asked Questions (FAQs)*, https://www.faa.gov/space/additional_information/faq/ (last visited June 8, 2021).

⁶ CNBC, *SpaceX Pushes Reusing Rockets Further with Record Sixth Landing of a Single Booster*, Aug. 18, 2020, <https://www.cnbc.com/2020/08/18/spacex-reuses-and-lands-falcon-9-rocket-booster-for-record-6th-time.html>.

⁷ FAA, *Commercial Space Data*, https://www.faa.gov/data_research/commercial_space_data/ (last visited June 5, 2021).

⁸ *Id.*

⁹ *Id.*

¹⁰ GAO, *Commercial Space Transportation: Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth*, GAO-19-437 at 8 (May 2019); information received from the FAA, email on file with Committee.

¹¹ *Id.*

FAA’s commercial space transportation activities under the FAA Reauthorization Act of 2018.¹²

III. THE FAA’S ROLE IN COMMERCIAL SPACE TRANSPORTATION

The FAA, under delegation by the Secretary of Transportation, exercises oversight of the commercial space transportation industry by authorizing commercial launches and imposing narrowly-tailored requirements or regulations to protect “the public, property, and the national security and foreign policy interests of the United States during commercial launch or reentry activities.” In addition, as part of its mission, the FAA is mandated to “encourage, facilitate, and promote U.S. commercial space transportation.”¹³

The FAA’s Office of Commercial Space Transportation (AST) is the focal point in the Executive Branch for authorization of a proposed commercial space launch. Consistent with its mission, AST regulates commercial space transportation by:

- *Licensing commercial launches and reentries* within the United States and those conducted by U.S. citizens anywhere in the world;
- *Licensing non-federal launch and reentry sites* (or “commercial spaceports”) operated within the United States or by the U.S. anywhere in the world;¹⁴
- *Granting experimental permits* for the launch of suborbital launch vehicles for research and development;¹⁵ and
- *Issuing safety approvals* for essentially all elements used in licensed or permitted launch and reentry activities, including launch and reentry vehicles, safety systems, processes, services, or personnel.¹⁶

A. LAUNCH LICENSES

The FAA may issue a launch license¹⁷ to the private operator of a proposed commercial space launch if the FAA concludes that the proposed launch would not jeopardize public health and safety or U.S. national security or foreign policy interests, or would be inconsistent with U.S. obligations under international law.¹⁸ The FAA recently published a new rule to streamline and replace numerous old regulations.¹⁹ In doing so, the FAA seeks to allow launch providers the ability be more flexible by: encompassing more types of launch and reentry operations; requiring only a single license for all types of commercial spaceflight launch and reentry operations; and adopting a performance standard over a prescriptive standard.²⁰

B. SPACEPORT LICENSES

While many commercial space launches occur at federal launch ranges (such as Cape Canaveral Space Force Station) that the FAA does not regulate, the FAA does issue licenses to nonfederal operators of launch and reentry sites, or “commercial spaceports.”²¹ There are also different kinds of launch ranges depending on type of launch vehicles intended to be supported, with some limited in size, and others limited on whether they takeoff horizontally (via runway) or vertically (via launch pad). There are currently 19 nominal launch and reentry sites in the United States, of which 12 are non-federal.²² In interviewing launch providers about U.S. spaceport capabilities and capacity, a GAO report from December 2020 found that a majority of launch providers feel that the current “U.S. space transportation infrastructure [is] generally sufficient [to meet] current requirements.”²³

¹² See *FAA Reauthorization Act of 2018* (Pub. L. 98–575), § 113(b); 49 U.S.C. § 106(k)(2)(D).

¹³ 51 U.S.C. § 50903.

¹⁴ See *Commercial Space Launch Act of 1984* (Pub. L. 98–575), 51 U.S.C. § 50904.

¹⁵ 51 U.S.C. § 50906.

¹⁶ See FAA Presentation to Committee Staff, *Introduction to the Office of Commercial Space Transportation (AST) at the FAA* (Mar. 13, 2017). See also *The Annual Compendium of Commercial Space Transportation: 2017*.

¹⁷ See 14 C.F.R. § 415.3.

¹⁸ 14 C.F.R. §§ 415.21; 415.31(a); 415.51.

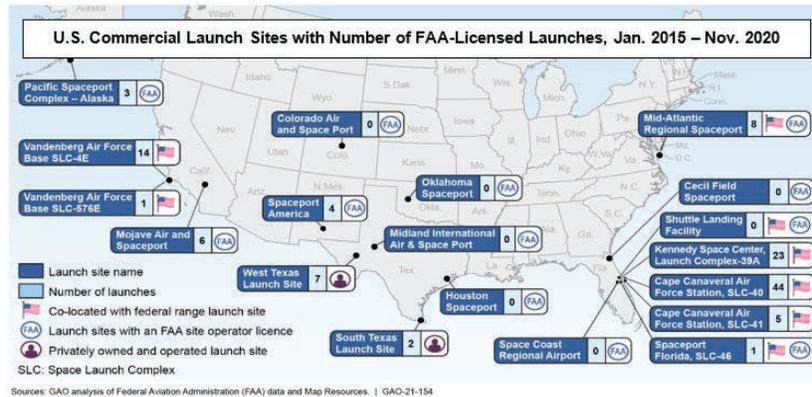
¹⁹ FAA, *Fact Sheet—Streamlined Launch and Reentry Licensing Requirements (SLR2) Rule* (Oct. 15, 2020), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=25400.

²⁰ *Id.*

²¹ FAA, *Fact Sheet—Commercial Space Transportation Activities* (June 19, 2020), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=19074.

²² GAO–21–154 at 7–11.

²³ *Id.*



C. EXPERIMENTAL PERMITS

The FAA also may issue a permit to the operator of an experimental space vehicle. Under this permit, the operator may launch a reusable suborbital rocket and return the vehicle to Earth, if the proposed operation is necessary for:

- (1) “[r]esearch and development to test new design concepts, new equipment, new operating techniques,” for crew training purposes; or
- (2) to show that the operator complies with the requirements above for obtaining a license.”²⁴

D. LIABILITY DETERMINATIONS AND INDEMNIFICATION

The operator of a licensed launch and reentry activity must obtain liability insurance or demonstrate financial responsibility sufficient to compensate for the “maximum probable loss” from claims by (1) a third party for death, bodily injury, or property damage or loss, and (2) the U.S. Government against a person for damage or loss to government property resulting from the licensed activity.²⁵ The FAA performs an analysis to determine the maximum probable loss, although commercial spaceflight operators are not required to obtain insurance or demonstrate financial responsibility of more than \$500 million for third-party claims and \$100 million for U.S. Government claims for property damage.²⁶ Federal law requires the U.S. Government to indemnify insured operators for third-party claims exceeding the \$500 million insurance requirement, up to \$1.5 billion, although to date such indemnification has not been necessary.²⁷

E. SAFETY APPROVALS AND OVERSIGHT

In addition to the functions described above, the FAA may issue safety approvals for many elements used in licensed or permitted launch and reentry activities, including launch and reentry vehicles, safety systems, processes, services, or personnel.²⁸ The FAA also conducts pre-application consultations, safety inspections and oversight (i.e., compliance monitoring for FAA-issued licenses and permits), environmental reviews, rulemakings, research, and infrastructure development.²⁹ Licensee and permit holders must allow the FAA to place an observer at launch, reentry, production facility, or assembly sites.³⁰

F. PAYLOAD REVIEW

In general, the FAA is not responsible for licensing or otherwise reviewing the payload of a commercial launch if the payload is a communications satellite licensed by the Federal Communications Commission, a commercial remote sensing satellite licensed by the National Oceanic and Atmospheric Administration (NOAA), or

²⁴ 14 C.F.R. § 437.5.

²⁵ 51 U.S.C. 50914(a).

²⁶ *Id.* at (a)(3).

²⁷ 51 U.S.C. § 50915(a).

²⁸ 51 U.S.C. § 50903; 14 C.F.R. § 414.

²⁹ FAA, *Workload Metrics*, Presentation, at 3, on Dec. 12, 2017, on file with Committee.

³⁰ *Id.*

owned or operated by the U.S. Government.³¹ If a payload does not fall into any of those categories, the FAA will conduct a payload review to ensure, in coordination with other federal agencies, that the cargo will not “jeopardize the public health and safety, safety of property, or national security or foreign policy interest of the United States.”³² Most recently, the FAA denied a payload review for a Momentus space tug intended to deploy cube satellites because of concerns raised by the Department of Defense (DoD) relating to the company’s foreign ownership.

IV. SAFETY AND INFRASTRUCTURE

A. *LEARNING PERIOD—MORATORIUM ON CERTAIN FAA REGULATORY ACTIVITY*

Although the FAA regulates the commercial space transportation industry to ensure the safety of the general public, Congress has established a “learning period” for the industry, which generally prohibits the FAA from proposing regulations for launch vehicle design features or operating practices as they relate to launch vehicle passenger or crew safety.³³ The FAA may, however, issue regulations in response to either (1) a serious or fatal injury to a person aboard a commercial spacecraft or (2) an event that posed a high risk of such an injury.³⁴

The intent of this moratorium is for the FAA to refrain from imposing unnecessary regulatory burdens on the nascent commercial human spaceflight industry. The learning period was last extended in 2015 and expires at the end of fiscal year 2023, which coincides with the expiration of the current FAA reauthorization law.³⁵ Over the next year, several companies are expected to be commercially carrying crew and passengers to space, which raises the question of whether Congress should extend the learning period, let it expire, or find an alternative regulatory framework.

Despite the moratorium, the FAA is working with the commercial space transportation industry to facilitate the development of voluntary industry consensus standards.³⁶ Much of this work occurs through ASTM Committee F47 on Commercial Spaceflight, which has published four consensus standards and is working on more than ten additional standards.³⁷ When the learning period expires, the FAA is required to take these or other consensus standards into account when developing any subsequent regulation.³⁸

B. *DUAL MANDATE*

In addition to regulating the safety of the U.S. commercial space transportation industry, the FAA is also required to “encourage, facilitate, and promote” the industry.³⁹ The FAA operated under a similar “dual mandate” with respect to civil aviation from its inception in 1958 until 1996, when the ValuJet flight 592 accident prompted Congress to eliminate the FAA’s statutory duty to “promote” as well as regulate the civil aviation industry.⁴⁰

C. *SPACE SITUATIONAL AWARENESS, TRAFFIC MANAGEMENT, AND MISSION AUTHORIZATION*

Presently, the DoD is responsible for providing space situational awareness services and information, meaning the tracking of space objects and warning satellite operators when the possibility of a collision exists.⁴¹ Collisions between objects in space pose a threat to human spaceflight safety and the continued operation of satellites due to severe debris pollution. For example, in 2009, the collision of an active and inactive satellite in orbit occurred at 26,000 mph and created almost 2,000 pieces of debris, all of which pose a potential threat to another satellite.⁴² To prevent similar collisions and provide other future services, there is widespread agree-

³¹ 14 C.F.R. § 450.43.

³² 51 U.S.C. § 50904(c).

³³ 51 U.S.C. § 50905(c)(2)(C)–(D), (9).

³⁴ *Id.*

³⁵ Compendium 2018, at 89. See *U.S. Commercial Space Launch Competitiveness Act*, Pub. L. 114–90, § 111 (2015). Before enactment of the legislation, the moratorium would have ended in 2018.

³⁶ 51 U.S.C. § 50905(c)(3).

³⁷ ASTM Intl., Committee F47 on Commercial Spaceflight, <https://www.astm.org/COMMITTEE/F47.htm>.

³⁸ 51 U.S.C. § 50905(c)(9).

³⁹ *Commercial Space Launch Act*, Pub. L. 98–575 (1984).

⁴⁰ *Federal Aviation Act of 1996*, Pub. L. 104–264, § 401 (1996).

⁴¹ 10 U.S.C. § 2274.

⁴² Weeden, *2009 Iridium-Cosmos Collision Fact Sheet*, Secure World Foundation (Nov. 10, 2010), https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf.

ment that space situational awareness services for civilian satellites should be performed by a civilian agency.⁴³

Space debris is not just a concern in orbit; an accident involving a spacecraft during launch or reentry or a reentering satellite could present a serious risk to users of the National Airspace System (NAS) as well as people on the ground. One of the most visible examples is the wreckage of the Space Shuttle *Columbia*, which broke apart during reentry on February 1, 2003. Parts of the shuttle were scattered through East Texas, Louisiana, and Arkansas, with one piece of wreckage—an 800-pound main engine piece—hitting the ground at nearly 1,400 miles per hour, and another 600-pound engine component impacting the ground with enough force to create a six-foot crater.⁴⁴ Most recently, in May 2021, a Chinese Long-March-5b vehicle re-entered the atmosphere. The nearly 40,000-pound vehicle was one of the largest ever to re-enter the Earth’s atmosphere on an uncontrolled basis and predicting its incoming flight path was near impossible. Pieces of it eventually crashed in the Indian Ocean.⁴⁵

While the FAA can close a portion of the U.S. airspace and evacuate the surrounding airspace to ensure safety from debris during a licensed launch or controlled reentry, it is more difficult to take appropriate actions with respect to uncontrolled orbital or suborbital objects. Reentering debris can pose a significant hazard to aircraft because fragments can fall through the airspace over considerable distances and at different rates. This creates the risk to an aircraft operating in the debris field.⁴⁶ This has led previous administrations and some experts to call for new requirements and mission authorizations to be placed on launch licenses to further weigh other considerations, such as orbit saturation and disposal.⁴⁷ Others have called for a civilian agency-led warning system, where the federal government would be able to better track and predict the trajectories of orbital debris and develop the capabilities for a civilian agency to manage and disseminate such data.⁴⁸

On June 18, 2018, President Trump issued Space Policy Directive-3 (SPD-3), which designated the Department of Commerce’s Office of Space Commerce as the lead civilian agency for the provision of space situational awareness services, the establishment of a space traffic management framework, and the reduction of orbital debris through preemptive and proactive means.⁴⁹ No mention was made of tracking reentering space debris to protect NAS users or people on the ground.⁵⁰ In 2020, the National Academy of Public Administration contracted with NOAA to review the Office of Space Commerce and issued a report recommending that the office conduct the civilian space situational awareness mission.⁵¹ Although a pilot program for such activities was funded in the Consolidated Appropriations Act, 2021, no legislation authorizing the Department of Commerce to provide space situational awareness services has been enacted by Congress.⁵²

⁴³ See *Space Situational Awareness: Examining Key Issues and the Changing Landscape: Hearing before Comm. on Sci., Space and Tech., Subcomm. on Space and Aeronautics*, 116th Cong. 3 (2020) (statement of Dr. Brian Weeden) at https://swfound.org/media/206932/weeden_house_ssa_testimony_written_feb2020.pdf; Sorge, Ailor, Muelhaupt, *Space Agenda 2021—Space Traffic Management: the Challenge of Large Constellations, Orbital Debris, and the Rapid Changes in Space Operations*, Aerospace Corporation—Ctr. for Space and Pol. Strategy (Sept. 2020), available at https://aerospace.org/sites/default/files/2020-09/Sorge_STM_20200915.pdf; Dominguez et al., *Space Traffic Management: Assessment of the Feasibility, Expected Effectiveness, and Funding Implications of a Transfer of Space Traffic Management Functions*, Natl. Acad. of Public Adm. (Aug. 2020), <https://napawash.org/academy-studies/untied-states-department-of-commerce-office-of-space-commerce>.

⁴⁴ Columbia Accident Investigation Board, *Report of the Columbia Accident Investigation Board*, Vol. I (Aug. 2003), at 46–47, available at http://s3.amazonaws.com/akamai.netstorage/anon.nasa-global/CAIB/CAIB_lowres_full.pdf.

⁴⁵ Saphora Smith, *Debris from China’s Long March 5B Rocket Crashes Back to Earth in Indian Ocean*, NBC News Digital (May 8, 2021).

⁴⁶ William Ailor, *Large Constellation Disposal Hazards*, The Aerospace Corporation (Jan. 2020).

⁴⁷ Letter from J. Holdren, Dir. Of Office of Sci. & Tech. Pol., to Chairman Thune and Chairman Smith (Apr. 4, 2016).

⁴⁸ Ailor, Wilde, *Requirements for Warning Aircraft of Reentering Debris*, 3rd Int’l Ass’n for the Advancement of Space Safety (Oct. 21, 2008).

⁴⁹ Presidential Memoranda, *Space Policy Directive-3, National Space Traffic Management Policy* (June 18, 2018).

⁵⁰ *Id.*

⁵¹ Dominguez et al., *Space Traffic Management: Assessment of the Feasibility, Expected Effectiveness, and Funding Implications of a Transfer of Space Traffic Management Functions*, Natl. Acad. of Public Adm. (Aug. 2020), <https://napawash.org/academy-studies/untied-states-department-of-commerce-office-of-space-commerce>.

⁵² Consolidated Appropriations Act, 2021, Pub. L. 116–260 (2020).

Despite the issuance of SPD-3 by the previous Administration, some have argued that the FAA is better suited for providing civilian space situational awareness services. The FAA has studied the issue with the DoD for years.⁵³ Most recently, on September 6, 2016, the Department of Transportation transmitted a report outlining the dangers of space debris to both existing space assets in orbit and those within atmosphere; the FAA’s expertise and existing relationships that would aid the agency in excelling at managing and relaying space situational awareness data; and the legislative approval and authorizations needed to do so.⁵⁴ Some experts have pointed out that the preexisting relationship between launch providers and a safety agency is crucial, as it also fulfills a long desired state of streamlined federal requirements regulated by as few differing agencies as possible.⁵⁵ Ultimately, the DoD is able and willing to work with whatever civil agency Congress entrusts with this mission; while testifying before the Committee on Armed Services in 2018, Air Force General John Hyten said, “We need a civil agency that is doing that role. Commerce makes sense. Transportation makes sense. That is a political decision.”⁵⁶

On April 16, 2021, Aviation Subcommittee Ranking Member Garret Graves and Chair Rick Larsen introduced H.R. 2624, the Aerospace Debris Safety Act, which directs the FAA to carry out a program to provide space situational awareness services, including a public catalog of space objects and emergency conjunction notifications for in-orbit space objects. It also directs the FAA to develop a system capable of tracking reentering space debris and using that space situational awareness data to restrict airspace or warn aircraft that may be at risk of being impacted by such debris.

D. HUMAN SPACEFLIGHT

Human spaceflight is inherently risky. Insofar as a trained and competent crew will reduce the risk of injury and damage to people and property on the ground, the FAA imposes requirements for the qualifications and training of mission crewmembers.⁵⁷ For example, launch vehicle pilots must have an FAA pilot certificate with an instrument rating and must have received vehicle and mission-specific training for each phase of flight.⁵⁸ A crewmember must also receive training “in procedures that direct the vehicle away from the public in the event the flight crew abandons the vehicle during flight” and “[a]bort scenarios,” and generally, a crewmember must demonstrate the ability “to safely carry out his or her duties so that the vehicle will not harm the public.”⁵⁹

E. SPACEPORT INFRASTRUCTURE FUNDING

Although commercial spaceports that are co-located with airports may receive federal support for airport-related infrastructure projects through the FAA’s Airport Improvement Program (AIP), there is no currently funded federal grant program dedicated to supporting commercial spaceports. Between 2010 and 2020, the FAA awarded 10 AIP grants to two airports that also have a launch site operator license, including for infrastructure that may support both airport and space transportation operations.⁶⁰ Between 2010 and 2012, the FAA awarded \$1.5 million in Space Transportation Infrastructure Matching grants to seven spaceports, although the program has not received funding since that time.⁶¹

In September 2020, the Commercial Space Transportation Advisory Committee (COMSTAC) recommended to the FAA that the federal government create a pro-

⁵³ Hitchens, *Will FAA Or Commerce Track Civil Satellites? Congress Must Decide—And Soon*, Breaking Def. (May 15, 2019), <https://breakingdefense.com/2019/05/will-faa-or-commerce-track-civil-satellites-congress-must-decide-and-soon/>.

⁵⁴ DOT, *Report on Processing and Releasing Safety-Related Space Situational Awareness Data* (Apr. 2016).

⁵⁵ Lal, Picard, Weeden, *Presentation—Approached to Civil Space Situational Awareness (SAA)*, FAA Industry Day—Sci. and Tech. Pol. Inst. (Oct. 25, 2016), https://www.faa.gov/about/office_org/headquarters_offices/ast/media/5_science_and_technology_policy_institute_study.pdf.

⁵⁶ *Space Situational Awareness: Whole of Government Perspectives on Roles and Responsibilities: Joint Hearing Before the Subcomm. on Strategic Forces of the Comm. on Armed Services Meeting Jointly with Subcomm. on Space of the Comm. on Sci., Space, and Tech.*, 115th Cong. 17 (2018) (statement of Air Force Gen. John Hyten), available at <https://www.govinfo.gov/contest/pkg/CHRG-115hrg33386/pdf/CHRG-115hrg33386.pdf>.

⁵⁷ 14 C.F.R. § 460.5(c).

⁵⁸ Foust, *Virgin Galactic pilots join an exclusive club with FAA astronaut wings*, SpaceNews (Feb. 10, 2019), <https://spacenews.com/virgin-galactic-pilots-join-an-exclusive-club-with-faa-astronaut-wings/>.

⁵⁹ 14 C.F.R. § 460.5(a)(2)(i), (b), (c)(4).

⁶⁰ GAO-21-154 at 18.

⁶¹ *Id.*

gram for funding improvements at spaceports.⁶² A COMSTAC working group suggested that such a program, run by the FAA’s Office of Spaceports, should be for capital improvements only, give priority to spaceport projects that secure state or local investment, and positively weigh existing launch activity at a spaceport in the grant award process.⁶³

V. NATIONAL AIRSPACE SYSTEM INTEGRATION

The FAA has the statutory responsibility for ensuring the safe and efficient use of the NAS. In the case of commercial space launches, the FAA establishes a hazard area each time there is a scheduled launch to segregate aircraft from the airspace needed for the launch.⁶⁴ The size of this hazard area is calculated prior to the launch due to the complexities involved, using variables like vehicle size, trajectory, and history.⁶⁵ Specifically, the risk to life outside of a hazard area must be equal to or less than a one-in-a-million or less chance that a piece of debris from a failed space launch vehicle would result in an injury to an individual member of the public.⁶⁶ Moreover, the hazard area must also be closed for a predetermined amount of time, as each launch has too many dynamic variables for it to integrate in real time with the FAA’s existing air traffic control system.⁶⁷

Since the hazard areas tend to be closed for the entirety of a launch window, regardless of whether a launch has been delayed or, in some cases, has already occurred, inefficiencies and delays may propagate for other users of the NAS who must be rerouted around said hazard area.⁶⁸ In fiscal year 2017, the FAA estimated that 1,200 commercial flights were directly affected by licensed launches, which resulted in an additional 39,000 miles flown, with a majority of these flights being directed around Cape Canaveral.⁶⁹ Although it is exceedingly rare, the FAA has previously denied a launch license due to the proposed timeframe being a “time of unusually congested airspace.”⁷⁰

The FAA, working with stakeholders, is engaged in efforts to resolve these inefficiencies and better integrate commercial space launches into the NAS. For instance, in February 2018, the FAA chartered an Aviation Rulemaking Committee to solicit recommendations on Airspace Access Priorities to minimize disruption by moving from space launch accommodation to integration.⁷¹ In May 2020, the FAA also published a Commercial Space Integration into the National Airspace System (CSINAS) Concept of Operations (ConOps).⁷² The ConOps describes the vision for future commercial space transportation operations, with an emphasis on managing the greater integration of launch and reentry vehicles as they transition through the NAS.⁷³ The FAA is also working on the technology needed to develop “time-based procedures and operator mission triggers” to more adaptively and reactively regulate the airspace around launches.⁷⁴ This includes new Space Data Integrator capabilities, which will receive and distribute launch and reentry data for initial use within the NAS and allow for improved situational awareness and airspace management decision making.⁷⁵

⁶² Letter from James A Hatt, Designated Federal Official COMSTAC, to Charity Weeden, Chair COMSTAC (Oct. 9, 2020) (regarding recommendations put forth by COMSTAC during the September 2020 meeting), available at https://www.faa.gov/space/additional_information/comstac/media/Sept_2020_AST_DFO_Response_to_COMSTAC.pdf

⁶³ Office of Spaceports Recommendation, COMSTAC (Sept. 14, 2020), available at https://www.faa.gov/space/additional_information/comstac/media/COMSTAC_IIWG_Spaceport_Funding_white_paper_14_Sept_2020.pdf.

⁶⁴ FAA, *Airspace Integration*, https://www.faa.gov/space/airspace_integration/ (last visited June 4, 2021).

⁶⁵ GAO–19–437 at 34.

⁶⁶ 14 C.F.R. § 415.35.

⁶⁷ GAO–19–437 at 34–36.

⁶⁸ FAA, *Airspace Integration*, https://www.faa.gov/space/airspace_integration/ (last visited June 4, 2021).

⁶⁹ GAO–19–437 at 36.

⁷⁰ *Id.* at 37.

⁷¹ FAA, *Airspace Access Priorities Aviation Rulemaking Committee Charter*, Feb. 12, 2018.

⁷² FAA, *Commercial Space Integration into the National Airspace System Concept of Operations* (May 2020), https://www.faa.gov/space/airspace_integration/media/Final_CSINAS_ConOps.pdf.

⁷³ *Airspace Integration*, *supra* note 65.

⁷⁴ *Id.*

⁷⁵ FAA, *Fact Sheet—The Space Data Integrator (SDI)*, (Oct. 16, 2020), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=23476.

VI. REGULATORY REFORM

In February 2018, the newly-revived National Space Council (NSC) recommended, among other things, that the FAA's launch and reentry licensing standards be streamlined within one year.⁷⁶ On May 24, 2018, President Trump signed Space Policy Directive-2, instructing the Secretary of Transportation to issue a notice of proposed rulemaking revising FAA launch and reentry regulations by February 1, 2019.⁷⁷ The directive required the Secretary to consider requiring a single license for all types of commercial space transportation launch and reentry operations, as well as replacing prescriptive regulations with performance-based criteria.⁷⁸

In response to Space Policy Directive-2, the FAA accelerated its efforts and chartered the Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee on March 8, 2018, in order to provide a forum for aviation stakeholders to provide input and recommendations.⁷⁹ The FAA issued a final rule streamlining its launch and reentry licensing requirements on October 15, 2020.⁸⁰ Overall, the final rule consolidated and revised multiple FAA regulations and applied a single set of licensing and safety requirements across various types of operations and vehicles, such as requiring a single license for all types of commercial spaceflight launch and reentry operations.⁸¹ In doing so, Parts 415, 417, 431, and 435 of the Code of Federal Regulations, which were predominantly prescriptive, were combined into a single performance-based rule, Part 450.⁸²

Despite the publication of Part 450, additional steps remain to fully implement the streamlined launch and reentry regulations. Many launch providers continue to operate under legacy licenses and have yet to transition to a license issued under Part 450. One reason for this is because full implementation of Part 450 will depend upon the FAA's publication of advisory circulars (ACs) that detail possible means of compliance with the regulation and other necessary guidance. To date, the FAA has only issued three ACs, although it plans to issue additional ACs over the next two years.⁸³

WITNESSES

PANEL 1

- Wayne R. Monteith, Associate Administrator for Commercial Space Transportation, Federal Aviation Administration
- Heather Krause, Director, Physical Infrastructure, Government Accountability Office

PANEL 2

- Salvatore T. "Tory" Bruno, President and Chief Executive Officer, United Launch Alliance
- Frank DiBello, President and Chief Executive Officer, Space Florida
- Captain Joe DePete, President, Air Line Pilots Association
- Mike Moses, President of Space Missions and Safety, Virgin Galactic

⁷⁶William Harwood, *National Space Council Acts to Streamline Regulatory Hurdles*, SpaceFlight Now (Feb. 22, 2018), <https://spaceflightnow.com/2018/02/22/national-space-council-acts-to-streamline-regulatory-hurdles/>.

⁷⁷Presidential Memoranda, *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/>.

⁷⁸*Id.*

⁷⁹FAA, *Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee Charter*, Feb. 12, 2018.

⁸⁰*Id.*

⁸¹*Id.*

⁸²*Id.*

⁸³See FAA, *Part 450: Means of Compliance Table*, https://www.faa.gov/space/streamlined_licensing_process/media/Part_450_Means_of_Compliance_Table_with_dates.pdf (last visited June 11, 2021).

STARSHIPS AND STRIPES FOREVER—AN EXAMINATION OF THE FAA’S ROLE IN THE FUTURE OF SPACEFLIGHT

WEDNESDAY, JUNE 16, 2021

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON AVIATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to call, at 2:04 p.m., in room 2167 Rayburn House Office Building and via Zoom, Hon. Rick Larsen (Chair of the subcommittee) presiding.

Members present: Mr. Larsen, Mr. DeFazio, Mr. Kahele, Mr. Garamendi, Mr. Stanton, Mr. Graves of Louisiana, Mr. Mast, Mr. Perry, Dr. Babin, Mr. Gimenez, Mr. Fitzpatrick, Mr. Payne, Ms. Norton, Dr. Van Drew, Mr. Stauber, Mr. Brown, Mr. Johnson of Georgia, Mr. Katko, Mr. DeSaulnier, Mrs. Steel, Ms. Williams of Georgia, Ms. Davids, Mr. Lynch, Mr. Burchett, and Mr. Balderson.

Mr. LARSEN. The subcommittee will come to order.

First off, I ask unanimous consent that the chair be authorized to declare a recess at any time during today’s hearing.

Without objection, so ordered.

And I ask unanimous consent that Members not on the subcommittee be permitted to sit with the subcommittee at today’s hearing and ask questions.

Without objection, so ordered.

As a reminder, please keep your microphone muted unless speaking. Should I hear any inadvertent background noise, I will request the Member mute their microphone.

A reminder as well: to insert a document into the record, please have staff email it to DocumentsT&I@mail.house.gov.

So good afternoon and I want to welcome today’s witnesses joining the Aviation Subcommittee’s hearing titled “Starships and Stripes Forever—An Examination of the FAA’s Role in the Future of Spaceflight.”

Earlier this year, NASA celebrated 60 years since Astronaut Alan Shepard made the first U.S. piloted spaceflight in the Mercury *Freedom 7* spacecraft, and since then space launches in the National Airspace System, or NAS, have increased.

Rigorous subcommittee oversight work helps guarantee U.S. aviation and aerospace remains the global gold standard in safety by identifying current and anticipated concerns, and identifying how Congress, the FAA, and industry and labor stakeholders can work together to address these issues.

The first panel today are representatives of the FAA and Government Accountability Office. They will discuss the status of Federal regulation and the oversight of the commercial space industry, necessary improvements, and the hurdles the FAA faces in carrying out its mission to provide the safest and most efficient aviation system in the world.

The second panel will help the subcommittee better understand how the industry navigates the current regulatory landscape for commercial spaceflight and what is needed in the future.

As chair and as a Member of Congress, I have also made improving diversity in the U.S. aerospace industry a priority. It is important the subcommittee hearings have diverse backgrounds, views, and perspectives at the table. However, in many cases, the U.S. transportation workforce lacks the diversity that reflects the true diversity of this country, a problem that extends to commercial space. So, unfortunately, it is not any different in the commercial space sector.

A recent survey of the aerospace and defense industry found that the number of women in the industry is around 24 percent, while only 6 percent of respondents identified as a person of color, and just less than 8 percent identified as Hispanic or Latino. As the industry works to increase the diversity of its workforce, I also expect to hear from the second panel today how they plan to address this. Until then, we will continue to work with stakeholders to find new ways for underrepresented groups to participate in the discussion and this industry.

The first panel today is the FAA and GAO.

Once the exclusive purview of the Federal Government, space launches in the U.S. are now a growing commercial industry. With this evolving dynamic has come an accompanying change in the role of the Federal Government. FAA is now tasked with overseeing not only the NAS and launches that may impact the NAS, but also regulations related to launch and spaceport licensing and safety regulations.

Mr. Wayne Monteith, FAA's Associate Administrator for Commercial Space Transportation, is here today to discuss these issues, as well as FAA's vision for this industry.

Ms. Heather Krause, the Director of Physical Infrastructure at the GAO, is also here today, and Ms. Krause will provide GAO's research that has been done on this topic, as well as recommendations for both the FAA and the industry.

[Mr. Larsen's prepared statement follows:]

Prepared Statement of Hon. Rick Larsen, a Representative in Congress from the State of Washington, and Chair, Subcommittee on Aviation

Good afternoon and welcome to today's witnesses joining the Aviation Subcommittee's hearing titled "Starships and Stripes Forever—An Examination of the FAA's Role in the Future of Spaceflight."

This is an overdue discussion on the future of the U.S. launch and spaceflight industry and the Federal Aviation Administration's (FAA) role in oversight of the industry.

Earlier this year, NASA celebrated 60 years since astronaut Alan Shepard made the first U.S. piloted spaceflight in the Mercury Freedom 7 spacecraft.

Since then, space launches in the National Airspace System (NAS) has skyrocketed.

The rigorous oversight work done by this subcommittee helps guarantee U.S. aviation and aerospace remains the global gold standard in safety by identifying issues of concern—current and anticipated—and how Congress, the FAA, and industry and labor stakeholders can work together to address these issues.

On our first panel are representatives from the FAA and the Government Accountability Office (GAO) to discuss the status of federal regulation and oversight of the commercial space industry, necessary improvements and the hurdles the FAA faces in carrying out its mission to provide the safest and most efficient aviation system in the world.

The second panel of witnesses will help the subcommittee better understand how the industry navigates the current regulatory landscape for commercial spaceflight and what is needed in the future.

One aspect I would like to make note of is that of diversity.

As Chair and as a Member of Congress, I have made improving diversity in the U.S. aerospace industry a priority.

It is important subcommittee hearings have diverse backgrounds, views and perspectives at the table.

However, in many cases, the U.S. transportation workforce lacks the diversity that reflects the true diversity of this country.

Unfortunately, the aerospace sector is no different. A recent survey of the Aerospace and Defense industry found that the number of women in the industry is around 24 percent, while only 6 percent of respondents identified as a Person of Color and just less than 8 percent identified as Hispanic or Latino.

As the industry works to increase the diversity of its workforce, I look forward to the day when it is similarly reflected in its leadership.

Until then, I will continue to work with stakeholders to find new ways for under-represented groups to participate in the discussion and this industry.

Once the exclusive purview of the federal government, space launches in the United States are a growing commercial industry.

With this evolving dynamic has come an accompanying change in the role of the federal government.

FAA is now tasked with overseeing not only the NAS and launches that may impact the NAS, but also regulations related to launch and spaceport licensing and safety regulations.

I am pleased to have Mr. Wayne R. Monteith, FAA's Associate Administrator for Commercial Space Transportation, here today to discuss these issues as well as FAA's vision for this industry.

I am also glad to have Ms. Heather Krause, Director of Physical Infrastructure at the GAO here today.

Ms. Krause will provide a wealth of knowledge on GAO's research done on this topic, as well as recommendations for both FAA and the industry.

The space launches that will be discussed in this hearing occur at various kinds of launch facilities—whether vertical or horizontal—and are designed to meet different commercial needs—such as launching a GPS satellite into GEO stationary orbit or a new telescope to explore space.

With that in mind, this subcommittee must consider the depth and breadth of the industry being regulated.

One perspective that must be heard is that of existing legacy launch service providers. Their experience surrounding long standing safety requirements and existing standards is extremely helpful in this conversation.

That is why I am pleased to have Mr. Salvatore "Tory" Bruno, President and CEO of United Launch Alliance (ULA) here today.

Mr. Bruno will be able to share insights as to the relationship between ULA and the FAA, and what is needed for the future of the commercial space industry.

I look forward to hearing more about what is needed from the FAA to support effective, yet efficient launch and spaceport licensing is vital to the success of the industry.

Also important in this discussion is what infrastructure investments are needed to continue the safe operation and continued growth of the commercial space industry.

I look forward to hearing from Mr. Frank DiBello, President and CEO of Space Florida, for his evaluation of the present and future of FAA launch and spaceport regulations.

FAA is still tasked with maintaining and safeguarding the NAS, in addition to its work on commercial space launches.

Recent figures indicate that the airline industry and passenger travel are rebounding from the COVID-19 pandemic.

The Transportation Security Administration (TSA) screened 2 million travelers at airport checkpoints on Friday, June 11—the most since March 2020.

Consequently, it is important to ask how to fully and safely integrate growing air-space operations, like commercial space launches, with existing airspace users.

The Air Line Pilots Association (ALPA) is a thought leader in this area. I am glad to welcome Captain Joe DePete, President of ALPA, to hear that perspective.

The perspective of new entrants into the commercial space operations field also play a key role in this discussion.

Companies still in the prototyping or design phase of operations view the regulatory landscape in a different light.

I am happy to welcome Mr. Mike Moses, President of Space Missions and Safety of Virgin Galactic, to hear their unique priorities.

As nascent operations and technologies are integrated into the complex national airspace system, the safety of all who fly and those on the ground remain the top priority.

Congress, the Biden administration and the commercial space industry and workforce must work together as we embark on the next chapter of U.S. aerospace.

Thank you again to today's witnesses. I look forward to our discussion.

Mr. LARSEN. In the interests of time, because we have votes, I will wait on discussing the second panel until we get to the second panel.

And with that, I will now call on the ranking member of the subcommittee, Mr. Garret Graves, for an opening statement.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman.

I want to thank Chair Larsen and Ranking Member Graves, and I also want to thank our witnesses for being here today.

Mr. Chairman, for many years, the commercial space transportation industry more than earned the moniker “nascent.” In fact, in 2011, the FAA licensed only one single commercial space launch, but in the past few years, it has been transformative. Nearly half of the more than 400 space launches licensed by the FAA have occurred since 2011. FAA now routinely licenses one launch a week or more. Three American companies will be taking passengers into space just this year, with a fourth set to join next year. In 2011, there were just over 1,000 active satellites in orbit. Now there are more than 3,300.

What used to be a science project is now a thriving transportation industry that transports passengers and hundreds of billions of dollars' worth of cargo to and from space.

As this industry continues to advance, it is important that we explore steps we should take to lay the foundation for the next decade of growth. The committee's number one priority is safety. While spaceflight is an inherently risky endeavor, we all know that there is no future for commercial space transportation unless launch vehicles are safe.

Although the FAA has a perfect public safety record for commercial space launches, a statutory learning period has restricted the issuance of launch vehicle crew and passenger safety regulations. This period of time, much like the early barnstorming days of aviation, has allowed time to work through the complexities of commercial space transportation and develop consensus standards.

After a slow start, the consensus standards work is gathering momentum. This policy has been very successful in promoting both growth and safety. The learning period expires in September of 2023, and Congress will need to decide whether to extend the learning period, let it lapse, or find an alternative policy solution.

It is an important question, and I look forward to hearing from our witnesses on this issue.

Adequate resources for the FAA's Office of Commercial Space Transportation, AST, and leveraging expertise of the private sector are also important issues. While launch cadences have increased by more than 400 percent over the last 5 years, AST staffing has increased by only 15 percent.

General Monteith recently led AST through a reorganization, and completely revamped the FAA's launch and reentry regulations. We should take a hard look at ensuring AST is as efficient as possible, that it has access to industry expertise, and that FAA resources don't hold the commercial space transportation industry back.

The increased launch cadences are also challenging our limited airspace resources. We must ensure that the FAA develops the tools and equipment necessary to safely integrate commercial space transportation launches into our National Airspace System.

But we cannot focus solely on the safety of our airspace at launch; we must also consider its safety when the objects return from space. That is why Chair Larsen and I recently introduced the Aerospace Debris Safety Act, which directs the FAA to establish a system to track reentering space debris, block affected airspace, and warn aircraft when such debris may pose a hazard. Even small satellites reentering the atmosphere can create debris clouds through which aircraft may fly. The bill also directs the DOT to provide space situational awareness data and services to ensure commercial space transportation safety on-orbit and to prevent the potential catastrophic collisions of satellites and debris.

Just this weekend, the G7 recognized the growing issue of space debris and the need for a collaborative approach for space traffic management. Although some have proposed to place these authorities in a different agency, I believe that the FAA is the right agency for the job.

Finally, I am excited to announce I have reintroduced the 21st Century Aerospace Infrastructure Act, which provides infrastructure improvement grants for commercial spaceports. These grants will represent an important Federal contribution to the capital needs of our national spaceport system and leverage State, local, and private investment in these assets.

Addressing these issues and others is critical to ensuring that we maintain our leadership in aerospace. I look forward to continuing to work on bipartisan solutions to these questions.

[Mr. Graves of Louisiana's prepared statement follows:]

Prepared Statement of Hon. Garret Graves, a Representative in Congress from the State of Louisiana, and Ranking Member, Subcommittee on Aviation

Thank you, Chair Larsen, and I also want to thank our witnesses for being here today.

For many years, the commercial space transportation industry more than earned the moniker of "nascent." In fact, in 2011 the FAA licensed only one single commercial space launch.

But the last few years have been transformative. Nearly half of the more than 400 space launches licensed by the FAA have occurred since 2011. The FAA now routinely licenses a launch a week or more. Three American companies will be taking passengers into space just this year, with a fourth set to join them next year.

In 2011, there were just over 1,000 active satellites in orbit; now there are more than 3,300.

What used to be a science project is now a thriving transportation industry that transports passengers and hundreds of billions of dollars' worth of cargo to, from, and within outer space. As this industry continues to advance, it is important that we explore what steps we should take to lay a foundation for the next decade of growth.

This Committee's number one priority is safety. While spaceflight is an inherently risky endeavor, we all know that there is no future for commercial space transportation unless launch vehicles are safe. Although the FAA has a perfect public safety record for commercial launches, a statutory learning period has restricted the issuance of launch vehicle crew and passenger safety regulations. This period of time, much like the early barnstorming days of aviation, has allowed time to work through the complexities of commercial space transportation and develop consensus standards.

After a slow start, the consensus standards work is gathering momentum. This policy has been very successful in promoting both growth and safety. The learning period expires in September 2023, and Congress will need to decide whether to extend the learning period, let it lapse, or find an alternative policy solution. This is an important question, and I look forward to hearing from our witnesses on this issue.

Adequate resourcing of the FAA's Office of Commercial Space Transportation (AST) and leveraging the expertise of the private sector are also important issues. While launch cadences have increased by more than 400 percent over the last 5 years, AST's staffing has increased by only 15 percent.

General Monteith recently led AST through a reorganization and completed a revamp of the FAA's launch and reentry regulations. We should take a hard look at ensuring that AST is as efficient as possible, that it has access to industry expertise, and that FAA resources don't hold the commercial space transportation industry back.

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Addressing these issues and others is critical to ensuring that we maintain our leadership in aerospace. I look forward to continuing to work on bipartisan solutions to these questions.

Mr. GRAVES OF LOUISIANA. Thank you again, Chairman Larsen, and I yield back.

Mr. LARSEN. Thank you, Ranking Member Graves.

Before I turn to the chair of the full committee, I would ask unanimous consent that the written statement prepared by the Commercial Spaceflight Federation be entered into the hearing record.

Without objection, so ordered.

[The information follows:]

**Statement of Karina Drees, President, Commercial Spaceflight Federation,
Submitted for the Record by Hon. Rick Larsen**

Chairman Larsen, Ranking Member Graves, and distinguished members of the Committee, thank you for accepting the Commercial Spaceflight Federation (CSF)'s submission of our members' views on the role of the FAA in the future of the U.S. commercial space industry.

Founded in 2006, CSF is focused on laying the foundation for a sustainable space economy and democratizing access to space for scientists, students, civilians, and businesses. CSF members are responsible for the creation of thousands of high-tech U.S. jobs driven by billions of dollars in investment. Through the promotion of technology innovation, CSF members are guiding the expansion of Earth's economic sphere, bolstering U.S. leadership in aerospace, and inspiring America's next generation of engineers, scientists, and explorers.

Commercial spaceflight is achieving the goals set for it by bipartisan leaders in Congress and prior Presidential Administrations. Those public servants had faith that American entrepreneurship and ingenuity could succeed in dramatically improving the safety, reliability, capability, and affordability of access to and return from space.

In 2021 we can see that this faith was well-placed. Our industry has reclaimed the overwhelming share of the global launch market. U.S. spacecraft aboard U.S. launch vehicles successfully resupply the International Space Station (ISS) with crew and cargo, filling a vacuum left by the Space Shuttle fleet's retirement a decade ago.

New market entrants with smaller launch vehicle designs are allowing climate-measuring and Earth observation spacecraft to supplement NOAA and NASA scientific observatories to help us understand and protect our environment. A range of new telecommunications satellites are providing better and more affordable services, including broadband for underserved and rural markets in the United States. Scientific experiments built by middle-schoolers and by post-graduate researchers are flying to the edge of space on suborbital reusable vehicles. And the Jet Propulsion Laboratory's latest Mars lander was able to flight-prove its approach and landing sensor package and software using a reusable launch vehicle.

Notably, two decades after Dennis Tito's flight to the ISS and nearly 17 years after Scaled Composites won the Ansari X-Prize, self-funded citizen explorers will fly commercially to both Earth orbit and on suborbital vehicles. The long-awaited era of personal spaceflight has finally arrived.

These achievements were enabled by the stable legal and regulatory regimes first put in place by Congress in the Commercial Space Launch Act of 1984 (CSLA) and updated regularly thereafter. CSF, in fact, recently published a white paper on the topic that elaborates on this regime and why it should be continued so that the benefits of growth and advancement in spaceflight can continue. But one core assumption of the CSLA and U.S. space policy has always been that space transportation, while being a nascent transportation mode, is dramatically different and distinct from aviation.

I. SPACE TRANSPORTATION IS NOT AVIATION

The first FAA Associate Administrator for Commercial Space Transportation (AST), the late Patti Grace Smith, was fond of saying that the FAA was one agency operating under two laws. The air side, or Title 49, of FAA manages the system of airports and airspace, and of course regulates all participants in aviation, from passengers to pilots to operators with one Cessna and airlines with several hundred jets. The much smaller space side of FAA, guided by Chapter 509 of Title 51, ensures the safety of the uninvolved public and their property, protects national policy goals, and enables industry growth by providing guidance, licenses, experimental permits, and promotional support including R&D.

Aviation is a common carrier industry with well over a century of technological development and 95 years of federal safety regulation. Much has changed since the dawn of aviation regulations, but the industry's safety record continues to improve while providing Americans with unprecedented mobility through safe, affordable travel.

Commercial space enjoyed its first licensed launch just three decades ago. The industry's shift beyond government contractor status was initiated a mere two decades ago, thanks in large part to the Air Force and NASA procuring launch services,

rather than owning and operating the physical hardware.¹ Today, new competing systems with diverse technologies and capabilities are maturing and in development, offering cheaper and faster access to space for both commercial customers and taxpayer-funded federal users.

II. HOW FAA CAN HELP THE FUTURE OF SPACEFLIGHT

While aviation safety must continue to be the priority of FAA, there are many additional public services that FAA leadership and the Office of the Secretary can and should provide to continue the progress of the U.S. commercial space transportation industry.

First and foremost is providing more resources to AST, both increased funding and the authority to hire more high-talent staff. AST employs a mere 100 of the 45,000 total FAA employees as it continues to wrestle with the dramatic growth in licensed and permitted spaceflights, and the need to simultaneously reform its public safety and related regulations so they are clearer for industry to understand, are technology-agnostic and performance-based instead of prescriptive, and also more straightforward and efficient to administer. CSF recommends an increase of nearly \$5 million more than the FY2022 request to at least \$37 million for AST Operations.

Second, DOT and FAA should provide AST with maximum flexibility in hiring both entry-level and mid-career engineers in addition to other technical experts who are fluent in the “NewSpace” paradigm of iterative design, test, operation and evolution of space systems. Furthermore, AST should be funded enough to enable a significant fraction of its employees to spend up to a year in industry to better understand the state of the art and its continuing advancement, or otherwise undertake frequent extensive training, site visits, and other enrichment opportunities regarding current industry technical practice. AST staff must be able to confidently assess the public safety of commercial space operations based on actual substance, and not rely solely on paperwork compliance.

Third, the Secretary should be encouraged to make full use of the authority granted by this subcommittee in the enacted FAA Reauthorization Act of 2018 to expedite the formal aerospace rulemaking process when appropriate and to work with both government and industry partners through a variety of interactive, transparent, and participatory mechanisms that are fully allowed under a broad interpretation of the Administrative Procedures Act. The goal should always be to try to create a consensus rulemaking to achieve the public goal at stake, and only rely on an entirely formal process if informal means fail. This is vital considering the need to streamline the remaining 14 CFR 400 et seq. now that Part 450 has been published. A significant amount of guidance documentation for Part 450 must be produced to allow for flexible means of compliance of this and other rules. There is no reason why industry cannot help AST draft that guidance.

Fourth, FAA should heed the advice it requested from a prior Aviation Rulemaking Committee regarding the issues around better integrating more frequent launches from and reentries to more geographic locations into its management of the National Airspace System. Specifically, the aviation and space transportation industries collectively told the FAA two years ago to invest in tools, which would give En Route controllers real time information about a launch event, including its dynamically changing hazard area, so they could steer air traffic around that event, preserving both passenger safety and efficient air and space operations. Unfortunately, the new FY2022 FAA F&E request cuts this funding and delays any investment decision until late next year. Correcting this should be a priority for Administrator Dickson, rather than solely Mr. Monteith.

Fifth, the U.S. space industry is exceedingly dependent on modernized infrastructure, particularly that which supports safe operation and more frequent usage. Unlike the early decades of aviation, when the Federal government provided significant funding for the nation’s emerging airspace system without charging corresponding user fees, no such program exists for commercial space transportation, and the burden of creating either public spaceports or private launch and reentry sites has been borne entirely by industry and state-and-local governments. There is an authorized program in law, but it needs updating and actual appropriations, and we would appreciate this committee’s support of a strong appropriation in FY2022, or the inclusion of space transportation infrastructure in the final infrastructure legislation that provides resources to DOT and the FAA.

¹This allowed industry to innovate far beyond the heritage of ICBMs that became the first generation of expendable launch vehicles in the late 1950s and 1960s and influenced designs into the 1990s.

Sixth, the FAA should continue its technical support of industry's development of consensus standards. Of the 89 recommended best practices to improve safety, provided by the FAA as prescribed in the 2015 CSLA, industry will have published or be in the process of drafting standards addressing a significant majority of those topics by the end of 2021. Additionally, compared to other similarly young industries, the commercial space industry is on par if not slightly ahead when it comes to creating safety standards. CSF hopes that the FAA can continue to help industry fashion standards as quickly and thoroughly as possible.

III. CONCLUSION

This year promises to be yet another breakthrough in U.S. commercial space transportation achievement. The future beyond looks just as bright, with significant benefits for our economy, our scientific, civil space, and environmental enterprises, and our national security. Soon nearly anyone who really wants will be able to fly themselves, an experiment, or a business idea into space. It is CSF's mission to democratize access to space for everyone, and 2021 will be a seminal year in that vital endeavor.

APPENDIX A

U.S. REGULATION OF COMMERCIAL SPACE TRANSPORTATION INTRODUCTION—THE COMMERCIAL SPACE LAUNCH ACT

Summary:

The U.S. Commercial Space Launch Act of 1984 as amended (51 USC 50901 et seq) is the primary law guiding federal oversight, regulation, and promotion of the U.S. commercial space transportation industry. The law mandates that the Secretary of Transportation ensure that all launch and reentry activities shall protect public safety and safety of property and support U.S. national security and foreign policy interests, and that the Secretary *shall issue* licenses to U.S. applicants who show that they do and will continue to meet those four canonical requirements. The proven success of this law—a growing and technologically dynamic U.S. industry with no public loss of life or significant property loss after 340 licensed commercial launches—has been recognized by other nation.

Background:

The first successful commercial launch took place in 1982, but the attempt required obtaining permission from approximately 40 federal, state, and local government organizations. Two years later Congress enacted the Commercial Space Launch Act of 1984 to create an enabling federal licensing regime under the U.S. Department of Transportation. The law requires that the Secretary, or her designee, protect the general public and their property, as well as ensure that the proposed launch is consistent with U.S. national security and foreign policy interests, but then mandates that any applicant who meets (and continues to meet) those requirements shall be issued a license to conduct a launch. The policy and regulatory framework are therefore consciously promotional in character: it encourages Americans to risk their money and sometimes their own personal safety to design, build, and launch commercial rockets into space.

The CSLA has been amended several times since 1984: to create a third-party liability risk-sharing regime, to cover intact reentries of launch vehicles or spacecraft, to license reusable launch vehicles, including reusable suborbital rockets, and to expressly authorize commercial human spaceflight. Meanwhile, many nations around the world have copied the U.S.' legal and regulatory framework to foster their own domestic space transportation industries, validating America's approach.

The Secretary's authority and responsibility was delegated by administrative action to the Federal Aviation Administration in 1996, resulting in the creation of an Office of the Associate Administrator for Commercial Space Transportation, which acts on behalf of the Secretary, but Congress has never affirmed this delegation in statute, other than authorization and appropriation of funding.

Key Points:

- The Commercial Space Launch Act as amended has enabled both early commercial launch vehicles derived from government-led systems, and now new generations of launch and reentry systems, including fully reusable vehicles, to enter the marketplace because developers enjoyed a stable, predictable, and reasonably transparent regulatory environment. Given the technical and economic challenges in rocket science, this bounding of regulatory risk (while still pro-

tecting American citizens and interests from harm) gives entrepreneurs and investors' confidence that they will get permission to fly.

- Critical to the regulatory regime's enabling nature is its exclusive focus on protecting the uninvolved public and their property, as well as essential national policy interests (such as treaty obligations). Commercial space transportation has never been regulated with the goal of the success of the mission. Indeed, space transportation continues to be seen as a dangerous and risky activity, i.e., not a common carrier mode of transportation with an expectation of safety and success for those who choose to participate in the activity. Indeed, space transportation customers regularly buy insurance to cover the cost of building and launching a replacement payload. Market forces therefore reward more reliable (as well as more economical) space transportation offerings. In the case of human spaceflight, the law requires the fully informed consent of all "spaceflight participants", and expressly limits regulation for their safety to demonstrated hazards, while enabling the Secretary to promote higher levels of occupant safety via guidance and information-sharing.
- The CSLA as a legal framework continues to enjoy broad approval from industry and other stakeholders and bipartisan support in Congress. While the law has been updated several times, its fundamental approach has remained consistent for nearly four decades. Importantly, the law has remained agnostic about technical approach, allowing for significant innovation, new market entries, and robust industry competition. The FAA's regulations, on the other hand, have come in for more criticism, especially in recent years, for being overly prescriptive and internally inconsistent. (See CSF white paper on *Streamlining Launch and Reentry Licensing Requirements*.)

APPENDIX B

THE COMMERCIAL SPACEFLIGHT FEDERATION'S (CSF) FY 2022 TRANSPORTATION, HOUSE AND URBAN DEVELOPMENT (THUD) APPROPRIATIONS PRIORITY REQUESTS

Agency: *Federal Aviation Administration*

Account: Operations

Commercial Space Transportation

FY22 CSF Request: \$37M / FY21 Enacted: \$27.56M / FY22 PBR: \$32.47M

Justification: FAA/AST continues to face a rapidly growing workload, with an unprecedented number of licensed launches and reentries, both by established firms and new market entrants. AST must conduct public safety and related analyses of increasingly frequent and more diverse launch and reentry activities even as it continues to implement the newly published Streamlined Launch and Reentry Licensing Requirements rulemaking (and careful transition of heritage launch/reentry operators to that new regime), as well as carry out other public-safety-related responsibilities. Finally, as industry continues to innovate with new vehicle designs, component technologies, and operating concepts, AST personnel would greatly benefit from more direct exposure and training opportunities regarding industry state of the art, using educational partnerships with industry and universities.

Requested Report Language: *The Committee recommends an increase in Commercial Space funding within FAA operations expressly for the purpose of efficiently and expeditiously processing operator applications for licenses and experimental permits to support the increasing cadence of commercial space launches and reentries. The Committee further recommends that the Office of Commercial Space Transportation continue to focus on its public safety mission, instead of planning for or pursuing uncertain future regulatory authorities. Finally, the Committee directs the Office to use some of the increase in funding above the President's request to provide its licensing staff with a range of training opportunities in industry state of the art technologies and practices.*

Space Transportation Infrastructure Matching Grants

FY22 CSF Request: \$60M / FY21 Enacted: \$0 / FY22 PBR: N/A

Justification: While first authorized long ago, this program has not been regularly funded in Presidential Requests, largely because high matching requirements make it less attractive than other federally funded transportation grant programs. But the growing number of diverse space transportation companies entering the marketplace is already taxing existing federal and non-federal infrastructure. It is hoped that this appropriation will stimulate the Department to begin to meet this growing national need to support commercial space transportation activities, many of which are in direct service of DOD, NASA, and other important federal customers.

Requested Bill Language: Sec. xxx. For the \$60 million appropriated within FAA Operations for the program authorized in 51USC511, the Secretary may waive the limitations of section (b) of that chapter for project grants only for launch or reentry operators and launch or reentry site operators, and instead require that at least 10 per cent of the total cost of the project will be paid by other sources.

Requested Report Language: *The Committee recognizes that non-federal spaceport infrastructure will require additional investment in the coming years to match projected launch and reentry demand, and so the Committee provides \$60,000,000 for the STIM-grant program, which was created to provide matching grants for infrastructure projects at launch or reentry sites. Given the budget pressure on state and local governments as well as private industry considering the COVID-19 pandemic, the Committee is proposing an Administrative Provision in the bill to reduce the matching funds requirement to just 10% for Fiscal Year 2022. This will enable federal funds to be used on space transportation infrastructure projects which support the national interest while also broadly supporting economic recovery.*

Account: Facilities & Equipment

ATC En Route Programs—Commercial Space Integration

FY22 CSF Request: \$16M / FY21 Enacted: \$11M / \$6.5M PBR

Justification: The FAA's Airspace Aviation Rulemaking Committee report completed in 2019 strongly recommended that FAA implement *existing* tools for sending real time hazard area information for a launch or reentry event via ERAM to en route controllers, allowing them to steer air traffic around the space transportation events and minimizing disruption to both aviation and space transportation. Unfortunately, so far, the NEXGEN organization has only implemented the Space Data Integrator to provide basic launch/reentry vehicle data to the FAA Command Center. The FY22 PBR indicates that FAA only plans to make an investment decision about further tool implementation in June of 2022, three years after the FAA's rule-making committee told FAA to focus on integrating hazard data into ERAM.

Requested Report Language: *The Committee repeats its direction that the Office of Commercial Space Transportation work with the NEXTGEN program to accelerate the further demonstration and operational approval of tools to transmit real time hazard area data to en route flight controllers to allow for dynamic management of air traffic around space launch and reentry activities and includes \$15m for Real Time Hazard Area Infusion.*

Account: Research, Engineering, and Development

Research, Engineering, and Development

FY22 CSF Request: \$6M / FY21 Enacted: \$5.84M / FY22 PBR \$5.75M

Justification: The FY2021 Conference Statement of Managers referred to a need to begin preparing for a potential expiration of limits on FAA's authority to regulate occupant safety, but this change is speculative, and it would not mandate regulation. Importantly, protecting the uninvolved public will remain a statutorily mandated paramount priority for FAA licensing of all space transportation activities. Furthermore, Congress directed in the Commercial Space Launch Competitiveness Act of 2015, and FAA agrees, that they should first focus on promoting occupant safety by facilitating the development of industry consensus standards based on the new design features, innovative technologies, and operating practices of the emergent commercial human space flight industry. The recommended request below would invest directly in the consensus standards effort identified by FAA's Commercial Space Transportation Advisory Committee as the agreed-on industry consensus choice for human spaceflight standards-writing.

Requested Report Language: *The Committee recommends that the Office of Commercial Space Transportation focus its promotion of human spaceflight occupant safety on supporting industry-led consensus standards development efforts and directs the Office to use at least \$1m of its RE&D request for an innovative public-private partnership for this purpose.*

Mr. LARSEN. With that, I will recognize the chair of the full committee, Representative DeFazio of Oregon.

Mr. DEFAZIO. Thank you, Mr. Chairman, and thanks to the ranking member for calling today's hearing to hear from the FAA and stakeholders on the Government's regulation of industry in the future of commercial space.

This is an important and growing sector, but there are three main points that I hope we can move through and hear meaningful conversation about during today's hearing. I want to hear from each witness their view on these three things: The imperative for better integration of launches and reentries into the air traffic system; the significant need for thoughtful regulation of this blooming largely unregulated industry; and the commitment to reducing the environmental damage associated with rocket launches.

We don't have any real recent statistics, but in December of 2018, 1,400 commercial flights containing many thousands of Americans were detoured 70,000 miles because of a launch. And in the future, with more and more launches, I would expect that we are going to see more and more delays. And I am not in favor of telling people in America who are traveling for pleasure or for work or family emergency, whatever reason they are on a commercial airplane, ah, sorry, your flight is going to be delayed, or, um, you are going to be 1½ hours late and miss your connection because some millionaire/billionaire is going to experience 15 minutes of weightlessness. That is not right, and I want to see that that does not happen.

I will give the FAA credit for being conservative in determining how much airspace to block off and how long. Safety is never subject to negotiation and compromise, and the FAA has rightly given these initial commercial space operations a wide berth to protect the safety of aircraft and flight.

However, I understand that in May 2020, the FAA finally published the long overdue "Concept of Operations" that details the vision to better integrate launch and reentry vehicles as they transition through the air traffic control system. I further understand the FAA is working on a system called the Space Data Integrator that will allow for more narrowly tailored airspace closures and designations, essentially real time, minimizing disruptions caused by commercial space activity. I am going to expect an update on that today, and I hope that the timeline is very short.

Second, it is time to end the FAA's dual mandate. I dealt with this when I was first a member of this committee. I sat in hearing after hearing and raised concerns about the idea that the FAA was the regulator and also the promoter of commercial aviation, something left over from the Civil Aeronautics Board, left over from the dawn of the aviation era in the United States.

I said, well, it is a mature industry, and I think it is a problem that you are regulating and promoting. And witness after witness from the FAA said, ah, no problem, no problem.

And then in the year of ValuJet, I tried again to strip out the promotion authority. My amendment was not approved. Then we were in conference. ValuJet went down. And I wasn't on the conference because I was pre-junior, but I got a call saying, hey, you know that amendment you had, that thing, where did we put it in the bill?

And this was the old days. If it wasn't in our bill and it wasn't in the Senate bill, you put it in the bill. And I said, well, it is not conferenceable, it wasn't in either bill. And they were, like, don't worry about that. And they stuck it in the bill, and we stripped away their promotional authority.

I intend to soon introduce legislation to do that. NASA can promote commercial space. The Commerce Department can promote it, whomever. The private sector can promote it themselves. It is not up to the FAA to promote commercial space and regulate it at the same time in the interests of public health and safety.

I also have a concern that Congress, with the agreement of successive administrations and the industry, has prohibited the FAA from regulating the design or operation of launch vehicles to protect the health and safety of passengers. We had a learning period, which was extended to 2023, and that means, despite commercial human spaceflight and space tours and soon expected to become emerging markets, the FAA's hands will be tied. They won't be able to regulate for the safety of the flying public. I even have serious concerns that some parts of the industry are talking about yet another extension of the moratorium.

And, then, finally, the issue of the environment. I want to talk about black carbon, other environmental effects of rocket launches. Black carbon is soot, primarily emitted from kerosene-fueled rocket engines like SpaceX Falcon 9 or United Launch Alliance's Atlas V, and can have a particularly detrimental effect on the Earth's upper ozone layer. These emissions remain in the stratosphere for 3 to 5 years, so the destructive effects aren't short term. At the moment they are only 1 percent of the depletion of the ozone. But the industry is growing, and it is estimated to grow tenfold in the coming years. So does that mean it will deplete 10 times as much of the ozone layer?

And then also, commercial space launch vehicles emit a stunning amount of carbon dioxide. The SpaceX Falcon Heavy rocket burns 400 metric tons of kerosene and emits more carbon dioxide in a few minutes than an average car would in two centuries of driving.

Now, other vehicles are less intrusive on the environment because they don't require rockets to leave the atmosphere. One flight of the Virgin Galactic SpaceShipTwo launch, a vehicle designed to launch customers to the low stratum of space, is only expected to produce about the same amount of carbon dioxide as for a business seat returning from London, and Virgin Galactic's president of space missions and safety, Mr. Mike Moses, is here today, so perhaps he can speak a little more about the environmental advantages of this type of launch vehicle.

But, more broadly, I want to hear from our industry stakeholders on what the companies are doing to address the environmental effects of space operations, because they have to be addressed and anticipated in the future.

These are my chief concerns about the trajectory of this growing industry, and I am really looking forward to this hearing to enlighten us on a path forward on some of these issues.

[Mr. DeFazio's prepared statement follows:]

Prepared Statement of Hon. Peter A. DeFazio, a Representative in Congress from the State of Oregon, and Chair, Committee on Transportation and Infrastructure

Thank you, Chair Larsen and Ranking Member Graves, for calling today's hearing to hear from the Federal Aviation Administration (FAA) and stakeholders on the growing commercial space industry and the government's regulation of that industry, or lack thereof.

I will make just three main points, and I would like to hear the witnesses' views on each of these: the imperative for better integration of launches and reentries into the air traffic system; the significant need for thoughtful regulation of this blossoming, largely-unregulated industry; and a commitment to reducing the environmental damage associated with rocket launches.

First, I want to hear what the FAA and the industry are doing to minimize the disruption to the air traffic system associated with commercial space launches and reentries. In fiscal year 2017 alone, the FAA re-routed 1,200 flights, adding in the aggregate 39,000 track miles to their routes, just to accommodate the commercial space industry's needs.

I will give the FAA credit for being so conservative when determining how much airspace to block off and for how long. Of course, safety is never subject to negotiation or compromise, and the FAA has rightly given commercial space operations a wide berth to protect the safety of aircraft in flight.

However, I understand that in May 2020, the FAA finally published the long overdue "concept of operations" that details the vision to better integrate launch and reentry vehicles as they transition through the air traffic control system. I also understand that the FAA is working on a system called the Space Data Integrator that will allow for more narrowly tailored airspace closures and designations of hazard areas, minimizing the disruptions caused by commercial space activity. I would like an update from our government witnesses on the status of deployment of those initiatives so we can ensure that millionaires and billionaires flying to space for a photo-op in the future won't inconvenience thousands if not millions of airline passengers.

Second, it's time to end the FAA's "dual mandate" of both regulating and promoting the commercial space industry. It is an anachronism, a paradox, and no serious safety regulator can regulate and promote at the same time. A regulator regulates. The FAA used to have a similar dual mandate to promote and regulate the airline industry. I recognized for years that the FAA's promotion and regulation of an industry could not coexist, and I tried for years to convince my colleagues in Congress to repeal the promotion authority. Tragically in 1996, ValuJet flight 592 went down in the Everglades, and only after that horrible tragedy were my efforts vindicated, and I championed a provision in the FAA reauthorization that year that ended the dual mandate with respect to the aviation industry.

I intend to introduce legislation soon that ends the FAA's dual mandate with respect to commercial space transportation. It's time for the FAA to assume the role of a thoughtful, unbiased regulator, and leave promotion of the industry to others.

I would also note that Congress, with the agreement of successive presidential administrations and the industry, has prohibited the FAA from regulating the design or operation of launch vehicles to protect the health and safety of passengers and crew on board space vehicles. In 2015, the moratorium—or "learning period"—on FAA regulation was extended to 2023. That means that despite commercial human spaceflight and space tourism soon expected to become emerging markets, the FAA's hands will be tied: the agency will be unable to fully regulate for the safety of those who participate.

I have serious reservations and concerns about the discussion in some parts of the industry to extend the moratorium yet again.

Finally, I want to talk about black carbon and other environmental effects of rocket launches. Black carbon is soot primarily emitted from kerosene-fueled rocket engines like SpaceX's Falcon 9 or United Launch Alliance's Atlas V and can have particularly deleterious effects on the earth's ozone layer. These emissions remain in the upper stratosphere for 3 to 5 years, so the destructive effects aren't short-term.

Although I recognize that rocket launches are currently responsible for only 1 percent of the total ozone depletion attributed to human causes, each percentage point adds up, and the industry is growing and by some estimates may expand by tenfold in the coming years.

Similarly, some commercial space launch vehicles emit a stunning amount of carbon dioxide. For instance, a SpaceX Falcon Heavy rocket burns about 400 metric tons of kerosene and emits more carbon dioxide in a few minutes than an average car would in more than two centuries.

Other vehicles are less intrusive on the environment because they don't require rockets to leave the atmosphere. For example, one flight of a Virgin Galactic SpaceShip2 Launch—a vehicle that is designed to launch customers to the low stratum of space—is expected to produce the same amount of carbon dioxide as a business class seat returning from London to New York on a commercial airliner. Virgin Galactic's president of space missions and safety, Mr. Mike Moses, is with us today, so perhaps he can speak more to the environmental advantages of this type of launch vehicle.

More broadly, I want to hear today from our industry stakeholders on what their companies are doing to address the environmental effects of commercial space operations. Because those effects must be addressed, and now.

These are my chief concerns about the trajectory of this growing industry. It's time for the FAA to minimize the disruption caused by launches and reentries, for the regulator to regulate, and for Congress, the executive branch, and the industry to address the measurable—and increasing—environmental effects of space launches.

Again, I thank Chair Larsen and Ranking Member Graves for holding today's hearing, and I look forward to hearing from our witnesses.

Mr. DEFAZIO. With that, Mr. Chairman, I yield back the balance of my time.

Mr. LARSEN. Thank you very much, Mr. Chair.

And I will welcome the witnesses of the first panel: Again, Mr. Wayne Monteith, Associate Administrator for Commercial Space Transportation at the FAA; and Ms. Heather Krause, Director of Physical Infrastructure of the Government Accountability Office. Thanks for joining us today, and we look forward to your testimony.

And without objection, our witnesses' full statements will be included in the record. Since that is the case, the subcommittee requests you limit your oral testimony to 5 minutes.

I will first recognize Mr. Monteith for 5 minutes.

Mr. Monteith.

TESTIMONY OF WAYNE R. MONTEITH, ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION; AND HEATHER KRAUSE, DIRECTOR, PHYSICAL INFRASTRUCTURE, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. MONTEITH. Thank you, sir.

Chair Larsen, Chair DeFazio, Ranking Member Graves, and Ranking Member Graves, thank you for the opportunity to discuss commercial space regulation.

What was once called the final frontier is now well within our reach. We thank the committee for its willingness to usher in this exciting sector of transportation that, quite frankly, was almost unimaginable. The future is here, and with our focus on safety and technology, we are indeed turning science fiction into real science, albeit rocket science.

The commercial space transportation industry in the United States is thriving at an unprecedented rate. The numbers are clear and unambiguous. This year, we will see an increase in licensed launches of over 400 percent in just the last 5 years. What that really means is we have gone from averaging one FAA-licensed launch about every 5 weeks to currently one launch about every 5 days.

As regulators, our focus is on all aspects of this burgeoning industry, but especially on safety. We view ourselves as a gateway,

not a hurdle, a conduit for safe progress, not redtape that keeps progress sitting on the launch pad.

In 2018, we started an intensive process to streamline our launch reentry regulations so we could create an environment to enable economic growth and innovation; minimize uncertainty; protect safety, security, and foreign policy interests; and be a leader in the commercial space transportation sector.

To these ends, we published the final rule to streamline our primary launch and reentry regulations to a single performance-based part to better fit today's fast evolving and growing commercial space transportation industry. We are currently developing and publishing advisory circulars to provide operators with additional guidance on how to meet the requirements of this new rule. This guidance includes safety procedures and practices for minimizing hazards and enhancing safety. Through these proactive efforts, we seek to put real action to the Department's mission of developing the safest, most efficient, and modern transportation system in the world.

And we continually analyze the regulatory needs of the industry for both public safety and an optimized regulatory framework. To that end, we are currently considering regulations for orbital debris mitigation during launch and reentry operations. This evaluation will include considerations of the risk to people on the ground and inform the risk to commercial aviation.

We are not alone in looking to the future. The Commercial Space Transportation Advisory Committee, COMSTAC, has recommended we specifically consider revising the rules regarding financial responsibility, so we will take a hard look at part 440.

This review will help ensure the public has the appropriate protections while also evaluating whether or not the rule has kept pace with industry. It will make sure the industry has clarity and flexibility to achieve the regulatory performance objectives without undue burden.

Spaceports are, in many ways, the front door to this industry, and we want U.S. leadership in space and on the ground. Without the proper infrastructure, commercial space won't have the foundation to make the jump from being a great idea to being the consistent, well-established mode of transportation we all know it can be. Spaceports aren't just for takeoffs and touchdowns. They are also economic and technology hubs just waiting to become a success story.

We have taken action to share information broadly on the capabilities of U.S. spaceports. Our web-based spaceport directory outlines U.S. spaceport infrastructure and capabilities and the services provided by FAA-licensed spaceports, Federal launch ranges, and private commercial spaceports. We are literally putting spaceports on the map.

The FAA also considers integrating commercial space operations into the National Airspace System a top priority. We are actively working on solutions to the issue of how commercial space will continue to grow alongside commercial and general aviation and drones. For example, we continue to develop and implement the Space Data Integrator. This safety-based technology, which will automate the current manual processes, will enable the FAA to

track, in real time, a space mission's progress as it flies through the airspace. When deployed, this technology will enable the FAA to better manage the airspace that must be closed to other users, and more quickly release airspace restrictions as a mission progresses; in other words, fully integrating commercial space transportation into the NAS.

In short, we are on the fast track to safely integrate commercial space into the system while enabling continued U.S. leadership in this transportation sector. We will continue to assess our entire regulatory framework in light of the industry's innovation and growth and look forward to working with Congress and industry to strike the appropriate regulatory balance; in other words, the right regulations of the right scope at the right time.

Mr. Chair, this concludes my testimony, and I will be glad to answer any questions from the committee.

[Mr. Monteith's prepared statement follows:]

**Prepared Statement of Wayne R. Monteith, Associate Administrator for
Commercial Space Transportation, Federal Aviation Administration**

Chair Larsen, Chair DeFazio, Ranking Member Graves, Ranking Member Graves, and Members of the Committee, thank you for the opportunity to meet with you today to discuss the topic of commercial space regulation. Commercial space activity is in the midst of a significant surge. The growth of the industry presents new challenges and opportunities as the technology evolves, and the number of industry participants expands. The FAA is committed to keeping pace with the growth of commercial space transportation, while prioritizing safety and ensuring access for all users of the National Airspace System (NAS).

COMMERCIAL SPACE OVERVIEW

The FAA, through the Office of Commercial Space Transportation (AST), licenses and permits the launch and reentry of commercial space vehicles consistent with public health and safety, safety of property, and the national security and foreign policy interests of the United States. The mission AST carries out includes the responsibility to encourage, facilitate, and promote U.S. commercial space transportation. These statutory objectives provide a framework that has resulted in an impressive safety record for a rapidly growing industry. The FAA has licensed or permitted over 450 launches and reentries, none of which has led to any fatalities, serious injuries, or significant property damage to members of the public.

The commercial space industry in the United States is dynamic, growing, and evolving. To illustrate recent growth, during each of the fiscal years (FY) 2018 through 2020, the FAA licensed an average of over 30 launches/reentries of commercial space vehicles. For FY 2021, we have already licensed 48 launches/reentries and expect significant growth in commercial launch activity beyond what we experienced over the last several years. Or, put another way, a decade ago the FAA licensed just a single launch in 2011. Five years ago, in 2016, the FAA licensed 11 launches, or about one per month. This calendar year, the FAA is averaging more than one licensed launch per week. As the industry continues to expand, the FAA has intensified its efforts to fulfill its commercial space mission, maintaining the highest level of safety without stifling industry growth.

A STREAMLINED COMMERCIAL SPACE REGULATORY FRAMEWORK

In 2018, the FAA began its work to streamline launch and reentry regulations to create an environment that promotes economic growth, minimizes uncertainty, protects safety, security, and foreign policy interests, and facilitates American leadership in space commerce. At that time, the existing commercial space regulatory framework was based largely on Federal launch standards that were developed in the 1990s or earlier, and were often overly prescriptive and a hindrance to innovation. Further, the rules were neither streamlined, nor consolidated. That regulatory structure may have satisfied the commercial space needs then, but the industry has changed substantially and continues to evolve. After two and a half years of focused

work, the FAA published a final rule on December 10, 2020, that consolidated, updated, and streamlined all launch and reentry regulations into a single performance-based part—14 CFR part 450—to better fit today’s fast-evolving commercial space transportation industry.¹ Part 450 includes regulations applicable to all launch and reentry vehicles, whether they have reusable components or not—a change from the prior framework. The updated regulations align with the goals of creating an environment that does not hinder industry innovation and importantly, enhances safety objectives without prescribing specific solutions. The commercial space industry provided extensive input during the public comment period for part 450, and we are pleased that initial reactions to the rule have been consistently positive. Additionally, after the rule was released, the FAA held a 3-day workshop and offered one-on-one meetings with companies to familiarize them with the final rule. Each operator who took advantage of these meetings conveyed that they were pleased with the final rule and appreciated our outreach efforts.

While the launch and reentry regulations have been published for several months and became effective on March 21, 2021, our engagement with industry on the requirements of the rules continues. AST has issued some advisory circulars to provide additional guidance on how to meet the requirements of part 450, and is developing more. We continue to engage with operators on specific aspects of part 450 compliance during pre-application consultations. Many of the advisory circulars that we anticipate issuing will provide detailed guidance for the industry on recommended safety procedures and practices for minimizing hazards. We expect that there will be launches licensed under part 450 in the near future.

OTHER REGULATORY CONSIDERATIONS

We are constantly analyzing the regulatory needs of the industry for both public safety reasons and to ensure that the commercial space regulatory framework is performance-based and does not inhibit the health and success of the industry. In support of that effort, the FAA is revising the regulations applicable to orbital debris mitigation for launch and reentry operations. As part of this work, we are evaluating appropriate national and international standards for orbital debris mitigation including evaluating the safety risks of uncontrolled reentries of space objects. These evaluations will include considerations of the risks to both commercial aviation and people on the ground.

Additionally, the Commercial Space Transportation Advisory Committee (COMSTAC) has recommended that part 440—Financial Responsibility—be reviewed and considered for revision. As part of our continuous review of the sufficiency of our commercial space regulations, we anticipate that a comprehensive analysis of this part would ensure that the right regulations with the right scope are in effect at the right time. Such a review would help to ensure that the public has the appropriate protections and that industry has clarity and flexibility to achieve the regulatory performance objectives without unnecessary burdens.

Part of AST’s responsibility is also to monitor commercial space transportation licenses to ensure they adhere to the conditions of their licenses and comply with the applicable regulatory and statutory requirements. In this regard, the FAA has broad authority to suspend or revoke a license, and impose civil penalties if necessary. The FAA takes our oversight responsibilities seriously to ensure licensees are in full compliance.

OFFICE OF SPACEPORTS

Keeping up with an industry that is evolving rapidly is a challenge. The pace at which the commercial space industry continues to change has resulted in an increase in both the complexity and the volume of the workload for AST. Some of that complexity has required us to make structural changes to better execute our mission. As this Committee knows, the FAA Reauthorization Act of 2018 required us to identify within AST a centralized policy office to support launch and reentry sites and to generally support improvement of spaceports. In response to that mandate, the Office of Spaceports was officially established in March 2020, and is functioning today. AST is committed to removing barriers to competitiveness for spaceports and to helping ensure that the United States leads the world in space infrastructure. The operation of the first non-Federal spaceport was licensed by the FAA in 1994, and there are currently 12 non-Federal spaceports across the United States licensed for launch or reentry operations. A spaceport license is valid for 5 years and is re-

¹ <https://www.federalregister.gov/documents/2020/12/10/2020-22042/streamlined-launch-and-reentry-license-requirements>

newable. While the FAA considers many factors when reviewing an application for a spaceport license, two of the most important are public safety and environmental impact. The FAA carries out a thorough and rigorous application review process to make sure we issue a license consistent with our mandate to protect public health and safety, safety of property, and the foreign policy and national security interests of the United States.

We recognize that spaceports have significant potential to become important economic hubs. For example, of the 47 FAA licensed launches this fiscal year, six have occurred at FAA licensed spaceports. As a result, the Office of Spaceports has taken action to share information on the capabilities of U.S. spaceports broadly. For example, in October 2020, we published a web-based spaceport directory outlining U.S. spaceport infrastructure and capabilities and the services provided by FAA licensed spaceports, Federal launch ranges, and private commercial spaceports. This directory documents the capabilities of our nation's network of spaceports for the commercial space transportation industry, as well as U.S. government space users, and may help to serve as a tool for the Office of Spaceports to identify future needs.

The Office of Spaceports is putting spaceports on the map. Spaceports or "Space Launch Activity Areas" are denoted as rocket symbols on aeronautical sectional charts increasing aviator awareness of launch or reentry activities in their area. The Office of Spaceports is also in the process of publishing additional instructional information about Space Launch Activity Areas in the FAA Airman's Information Manual that will encourage aviators to check notices to airmen in these areas for additional launch or reentry specific information. These efforts help to integrate space and aviation activities and increase overall safety of the NAS.

The Office of Spaceports also facilitates FAA review and approval of space-related activities at FAA licensed spaceports to enable a stronger commercial space transportation industry. These activities include rocket engine testing, flight corridor development for supersonic, hypersonic, and suborbital space activities, and beta testing of new space launch platforms for future use by the commercial space transportation industry. Further, the Office of Spaceports works to facilitate commercial support for launches from Federal launch locations. Finally, the Office of Spaceports is evaluating whether the FAA's spaceport regulations (part 420 and 433) for launch and reentry sites should also be updated.

INTEGRATION OF COMMERCIAL SPACE INTO THE NAS

Of the many challenges AST faces, integration of commercial space into the NAS is a top priority. Commercial space operations are currently treated as "special cases" in which air traffic controllers block off large sections of airspace for extended periods of time for a single launch. Although this process is currently manageable, it is unsustainable in the long run given the expected growth in commercial space launches. Moreover, the current process, while effective, is resource intensive and inefficient. Launch teams voluntarily provide real-time information concerning the status of a launch or reentry vehicle either over the telephone or over an internet connection. Under these limitations, launch teams can only support one mission at a time.

In AST, we are actively working on solutions to address how commercial space will grow within the NAS alongside commercial and general aviation. Our vision of spaceport operations is that they should be able to operate either co-located with airports or in close proximity to them. To this end, we are working on multiple initiatives. We worked with the FAA's William J. Hughes Technical Center in Atlantic City, New Jersey to build the agency's first dedicated commercial space integration lab for developing and prototyping technologies that will be leveraged towards enhancing commercial space operation awareness to better manage the NAS. Additionally, AST continues its work with the FAA's Air Traffic Organization on the Space Data Integrator technology. This safety-based technology, which will automate the current manual processes, will enable the FAA to track a space mission's progress as it flies through the airspace. When deployed, this technology will enable the FAA to better manage the airspace that must be closed to other users and more quickly implement and release airspace restrictions as a mission progresses. At the FAA, we recognize that our role is not just limited to the safety of the airspace—but to ensure equal access to it as well. We are fully engaged in balancing the needs of all airspace users—including traditional manned aircraft, drones, commercial space transportation, and others.

CONCLUSION

In closing, the FAA is committed to effectively carrying out its responsibilities for public safety and the health of the commercial space transportation industry. We

will continue to assess our entire regulatory framework in light of the industry's growth and look forward to working with Congress and industry to strike the appropriate balance. This concludes my testimony, and I will be glad to answer any questions from the Committee.

Mr. LARSEN. Thank you, Mr. Monteith.

The Chair will now recognize Ms. Krause from the GAO for 5 minutes.

Ms. KRAUSE. Chairman Larsen, Chairman DeFazio, Ranking Members Graves and Graves, and members of the subcommittee, thank you for the opportunity to discuss today's commercial space transportation industry and FAA's role.

Since FAA first assumed regulatory responsibility in 1995, this industry has experienced substantial growth, especially in the more recent years. Over time, commercial launch providers have made hundreds of launches involving carrying astronauts and supplies to and from the International Space Station, and delivering thousands of satellites that support global television, high-speed internet, weather forecasts, and much more.

In 2020, FAA oversaw a record number of launches and reentries. These operations are forecasted to grow as new space applications emerge, such as human space tourism, and demand continues to increase for services that depend on space transportation.

My testimony today is based on our work since 2006 on FAA's efforts to respond to the changing commercial space transportation environment. It focuses on three areas: One, FAA's efforts to update regulations; two, challenges FAA faces regulating an industry that continues to grow and evolve; and, three, steps FAA has taken to help ensure it is positioned to respond to industry changes.

First, industry developments have necessitated that FAA review and update its regulations. Most recently, FAA focused on its launch and reentry licensing regulations, consolidating multiple regulations and replacing prescriptive requirements with a performance-based regulatory framework to help better accommodate industry changes. Given that focus, FAA placed on hold revisions to other regulations, including those related to site operator licensing, which has been in place since 2000, and financial responsibility, which ensures a balance of risk between the Federal Government and launch companies, and contain key elements not updated since 1988. FAA plans to prioritize and review these regulations following its licensing efforts, which aligns with the recommended priorities of its industry advisory committee.

As FAA adapts its regulations, it also faces ongoing oversight challenges. One key challenge we previously identified is whether and when to regulate the safety of crew and spaceflight participants. While companies have announced plans to take tourists to space within the next several years, FAA is prohibited by statute from regulating current passenger safety before 2023, except in response to events that caused or posed a risk with serious or fatal injury.

In its February 2019 report to Congress, FAA concluded that no commercial human spaceflight activities had advanced to a stage that would necessitate a new safety framework. However, in anticipation of the moratorium expiring, FAA has taken some steps, in-

cluding working with industry, to develop and disseminate human spaceflight best practices.

In addition, the rise of space tourism may require reexamination of FAA's dual role of overseeing the safety of commercial space launches and promoting the industry. A 2008 statutorily mandated report concluded that there was no compelling reason to remove FAA's promotional role through 2012, but recommended that DOT periodically review its dual role, specifically for safety and promotion of human spaceflight. Given the time passed since the last examination and the moratorium on regulating spaceflight safety is due to expire, such a review may be warranted.

Finally, FAA has taken some steps to help the agency keep pace with industry changes. For example, in response to recommendations we made in 2015 and 2019, FAA assessed its workforce to identify skills and competencies that are needed and is improving its workload projections to better account for the full range of its regulatory activities. Such efforts are critical for ensuring FAA strategically aligns its workforce with evolving industry demands.

FAA has also made progress in developing procedures, technologies, and industry coordination to reduce inefficiencies and safely integrating commercial space users into the National Airspace System. These efforts are promising, but full and efficient integration of all users of the National Airspace System is years away and will require continued work and focus.

In closing, the commercial space transportation industry provides services that are essential to many aspects of Government, business, and society, and these services are expected to increase. FAA's role is fundamental to the continued safe growth of the industry. It is critical for FAA to maintain progress, and ensure its efforts anticipate and respond to industry changes.

This concludes my statement. I look forward to answering your questions.

[Ms. Krause's prepared statement follows:]

**Prepared Statement of Heather Krause, Director, Physical Infrastructure,
U.S. Government Accountability Office**

COMMERCIAL SPACE TRANSPORTATION

FAA CONTINUES TO UPDATE REGULATIONS AND FACES CHALLENGES TO OVERSEEING AN
EVOLVING INDUSTRY

What GAO Found

The Federal Aviation Administration (FAA) recently updated and streamlined its launch and reentry licensing regulations but has made less progress on other key commercial space transportation regulations. The new licensing regulations, issued in December 2020, replaced prescriptive requirements—in which a certain technology or action was required—with a performance-based regulatory framework, which provides applicants flexibility in how they achieve required outcomes, such as a specific level of safety. Given its focus on the licensing regulations, FAA placed on hold revisions to other regulations governing commercial space transportation—revisions which, according to FAA officials, are warranted given the industry's evolution. For example, FAA has not yet begun to revise its financial responsibility regulations, which require launch companies conducting FAA-licensed launches to purchase insurance to cover damage to third parties in case of a launch mishap. According to FAA officials, revising these regulations is their next planned rulemaking and when finalized, will respond to GAO's recommendations to improve FAA's methodologies for evaluating and calculating potential third-party losses from launch and

reentry mishaps and help ensure the federal government is not exposed to greater liability than expected.

FAA also faces ongoing challenges regulating an evolving industry. In particular, as GAO previously reported, FAA continues to face the challenge of whether and when to regulate the safety of crew and spaceflight participants. While some companies have announced plans to take tourists to space within the next several years, FAA is prohibited by statute from regulating crew and passenger safety before 2023, except in response to events that caused or posed a risk of serious or fatal injury. However, FAA has taken some steps in anticipation of the expiration of the statutory moratorium, such as working with its industry advisory committee to develop and disseminate human spaceflight best practices.

FAA also has taken some steps to help the agency keep pace with changes in the industry. For example, in response to recommendations GAO made in 2019, FAA recently assessed its workforce to identify skills and competencies that are needed among its workforce and is working to improve its workload projections to better account for the full range of its regulatory activities and the timeline of its licensing process. Such efforts are critical for ensuring FAA can better anticipate and respond to the growing and evolving commercial space industry and FAA's emerging workforce needs.

Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee:

Thank you for the opportunity to testify today on developments in the commercial space transportation industry and the Federal Aviation Administration's (FAA) oversight. Since 1995, when FAA first assumed regulatory responsibility for commercial launch companies and operators of launch sites, the industry has experienced substantial growth and evolution.¹ Over the years, commercial launch providers have made more than 400 launches and reentries carrying astronauts and supplies to and from the International Space Station and delivering thousands of satellites to space that support global television, high-speed Internet, weather forecasts, and much more. Globally, commercial launch providers generated an estimated \$5 billion in revenue in 2019, up from about \$2.4 billion in 2012. FAA has licensed an increasing number of launches since 2015—an average increase of 41 percent year-over-year as of December 2020.² In addition, FAA reports that the number of unique commercial launch providers holding, modifying, or potentially seeking an FAA license has increased from 23 in August 2015 to 39 in June 2021. FAA and the commercial space transportation industry itself forecast continued growth and evolution as new space applications continue to emerge, such as human space tourism, and demand continues to increase for large constellations of small satellites that depend on space transportation services.

My testimony today focuses on (1) FAA's efforts to update regulations governing commercial space transportation, (2) challenges FAA faces regulating an industry that continues to grow and evolve, and (3) steps FAA has taken to help ensure it is positioned to meet the needs of the evolving industry. This statement is based largely on our work since 2006 on industry developments and challenges faced by FAA.³

To conduct our prior work, we reviewed relevant statutes and regulations. We also reviewed FAA documents on its oversight of the commercial space transportation industry and interviewed officials from the responsible FAA organizations, most notably the Office of Commercial Space Transportation (AST). In addition, we interviewed a range of industry stakeholders to discuss the industry's growth and evolution, as well as to obtain their perspectives on FAA's oversight. More detailed information on our objectives, scope, and methodology can be found in each of the reports.

¹The Commercial Space Launch Act of 1984, Pub. L. No. 98-575, 98 Stat. 3055, established commercial space launch responsibilities with the Department of Transportation, which were subsequently transferred to FAA.

²According to FAA officials and several industry stakeholders, the on-going Coronavirus 2019 global pandemic has had minimal effect on the commercial space transportation industry.

³See, for example, GAO, *Commercial Space Launches: FAA Needs Continued Planning and Monitoring to Oversee the Safety of the Emerging Space Tourism Industry*, GAO-07-16 (Washington, D.C.: Oct. 20, 2006); *Federal Aviation Administration: Commercial Space Launch Industry Developments Present Multiple Challenges*, GAO-15-706 (Washington, D.C.: Aug. 25, 2015); *Commercial Space Launch Insurance: FAA Needs to Fully Address Mandated Requirements*, GAO-18-57 (Washington, D.C.: Jan. 16, 2018); and *Commercial Space Transportation: Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth*, GAO-19-437 (Washington, D.C.: May 23, 2019).

For this statement, in June 2021, we interviewed FAA officials about recent FAA actions, including those to address the recommendations in our prior reports, as well as developments in the industry. We also reviewed applicable FAA regulations and documents produced by FAA's Commercial Space Transportation Advisory Committee (COMSTAC)—a group of industry members and others who provide FAA with information, advice, and recommendations related to commercial space transportation.

We conducted the work on which this testimony is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

BACKGROUND

Space transportation is the movement of objects, such as satellites and vehicles carrying cargo, scientific payloads, or passengers, to or from space. In the United States, commercial space transportation is carried out using orbital and suborbital launch vehicles owned and operated by private companies referred to as commercial launch providers.⁴ A site operator is the entity that hosts the launch (or reentry, or both) of the launch vehicle from its launch site. Almost all launch site operators are either commercial launch providers or state or municipal government entities.

FAA's Office of Commercial Space Transportation

Within FAA, AST is responsible for regulating the U.S. commercial space transportation industry to oversee and coordinate the conduct of commercial launch and reentry operations, and to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States. AST conducts its oversight mainly by licensing or permitting commercial launch and reentry vehicle operations and non-federal launch sites, as well as conducting safety inspections of licensed launch providers and site operators. AST is also charged with encouraging, facilitating, and promoting the industry.⁵

In addition, to assist in the development of the commercial space launch industry, the federal government shares liability risks for losses from damages to third parties or federal property. AST is responsible for determining maximum probable loss (MPL), which is the greatest dollar amount of loss for bodily injury or property damage that is reasonably expected to result from a licensed or permitted activity. This MPL determination forms the basis for financial responsibility requirements AST issues in a license or permit order.⁶ The federal government is potentially liable for damages above the MPL, subject to appropriation, up to \$3.36 billion in 2021 (the equivalent to \$1.5 billion in 1988).⁷ Anything above this amount is the responsibility of the launch or reentry licensee, which may seek additional insurance but is not required to under federal law.

AST's workforce size and operations budget has increased over recent years (about 34 percent and 66 percent, respectively, since 2016) to help accommodate growth in the industry and AST's workload (see table 1). DOT is also requesting an increase of almost \$5 million for AST's FY2022 operations budget to support the anticipated growth within the commercial space transportation industry.

⁴Orbital launch vehicles are those launched with enough velocity to achieve orbit around the Earth. Suborbital launch vehicles are those that reach space but do not have sufficient velocity to achieve orbit.

⁵14 C.F.R. § 401.3.

⁶As part of a launch license, FAA requires launch companies to purchase insurance to cover losses to third parties or damage or loss to U.S. government property in the event of a commercial launch or reentry accident. 51 U.S.C § 50914; 14 C.F.R. §§ 440.5, 440.9. FAA calculates the insurance amount to reflect the maximum probable loss that is reasonably expected to occur because of a mishap that results in (1) third-party damage, including deaths and injuries on the ground and damage to property caused by anything that resulted from a launch or reentry, and (2) damage to government property. 14 C.F.R. § 440.7.

⁷Since 1988, the federal government has sought to assist in the development of the commercial space launch industry by sharing liability risks for accidents leading to damages to third parties or federal property and personnel. This risk-sharing arrangement requires that commercial launch providers purchase insurance against claims by third parties and for loss or damage to federal property and personnel up to a maximum probable loss (MPL) amount.

Table 1: Office of Commercial Space Transportation Staffing and Operations Budget Fiscal Years 2015–2021

Fiscal year	Full time permanent	Operations budget (in millions)
2015	81	\$16.61
2016	106	\$17.80
2017	106	\$19.83
2018	97	\$19.70
2019	108	\$24.95
2020	108	\$26.04
2021	109	\$27.56

Source: GAO presentation of Federal Aviation Administration data / GAO–21–105268

Industry Trends

In addition to the increasing number and frequency of launch and reentry operations, industry developments, according to FAA officials, necessitate that FAA amend its regulations and adjust its workforce skills and competencies. For example, more commercial providers are introducing reusable elements into the design of their vehicles where one part or all of the launch vehicle returns to a runway or landing pad. AST found that these new vehicles rendered some parts of its regulations on reusable launch vehicles—originally established in 2000—obsolete, and required revisions to portions of its launch vehicle licensing regulations.⁸ In addition, companies are developing new technologies, such as autonomous flight safety systems, which allow the flight of a launch vehicle that is off course to be aborted⁹ without humans taking action, and new launch vehicle propulsion systems, which, according to FAA officials, require specific AST workforce skills or expertise to evaluate certain launch license applications.

We have previously reported that commercial launch providers have also been testing reusable suborbital launch vehicles intended for human space tourism, which are now expected to launch soon.¹⁰ These vehicles include horizontal hybrid suborbital launch vehicles, such as Virgin Galactic’s SpaceShipTwo, and vertical reusable suborbital launch vehicles, such as Blue Origin’s New Shepard. Blue Origin recently announced that its first flight with a commercial customer is scheduled for July 2021, and Virgin Galactic is planning to launch its first commercial customers in 2022.

As the number of launches and reentries continues to grow, the number of operators of launch and reentry sites that FAA has licensed to host commercial launches has also increased. In 2006, FAA had licensed six launch site operators. By December 2020, FAA had licensed site operators for 12 U.S. launch sites, with nine additional entities seeking licenses for 11 prospective U.S. launch sites. As we reported in 2020, despite the increase in the number of licensed site operators, the majority of FAA-licensed commercial launch operations take place at seven sites that do not require an FAA site operator license; that is, at exclusive-use launch sites where a single company conducts launches either at its privately owned and operated site or at an exclusive-use launch complex that is on or co-located with a federal range. FAA officials told us that exclusive-use launch sites do not require a site operator

⁸ 14 C.F.R. pt. 431 addresses the requirements for obtaining a reusable launch vehicle mission license. The FAA amended its regulations to establish these operational requirements in November, 2000. Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations, 65 Fed. Reg. 56,618 (Sept. 19, 2000).

⁹ 14 C.F.R. § 401.7 states that “[f]light abort means the process to limit or restrict the hazards to public safety, and the safety of property, presented by a launch vehicle or reentry vehicle, including any payload, while in flight by initiating and accomplishing a controlled ending to vehicle flight.”

¹⁰ In May 2020, for the first time since NASA’s space shuttle was retired in 2011, astronauts were launched from U.S. soil to the International Space Station. While not an FAA-licensed launch, NASA coordinated with FAA. NASA also has plans to partner with a private launch company to fly tourists to the International Space Station planned for later 2022.

license, as public safety requirements are met through that single launch provider's launch license.¹¹

FAA RECENTLY STREAMLINED ITS LAUNCH AND REENTRY REGULATIONS BUT LESS PROGRESS HAS BEEN MADE ON OTHER KEY COMMERCIAL SPACE TRANSPORTATION REGULATIONS

FAA Issued a Final Rule for Launch and Reentry Licensing in December 2020

In response to a May 2018 Presidential Directive,¹² AST accelerated its approach to updating its launch and reentry licensing regulations and issued a final rule in December 2020 that streamlined those regulations in two key ways.

- The rule consolidated multiple regulatory parts to create a single licensing regime for all types of commercial space flight launch and reentry operations.
- The rule replaced prescriptive requirements—in which a certain technology or action is required—with a performance-based regulatory framework, which provides applicants flexibility in how they achieve required outcomes, such as a specific level of safety.

With few exceptions the final rule's requirements are in effect,¹³ though FAA is still finalizing most of its guidance materials, the purpose of which is to provide transparency and help licensing applicants understand the new requirements. As of June 8, 2021, all new applicants for a launch or reentry license will be required to meet the requirements in the final rule.

As of June 2021, AST had held some industry workshops on the new requirements and had finalized three of the nearly two dozen total advisory circulars (i.e., guidance documents) that it plans to issue by the end of 2022.¹⁴ FAA officials told us that they also meet individually with license applicants to provide guidance.

FAA Has Plans to Update Other Key Commercial Space Transportation Regulations

Financial Responsibility Regulations

To date, FAA has made little progress in improving its methodology for calculating potential third-party losses from launch and reentry mishaps and updating its related financial responsibility regulations.¹⁵ The federal government's shared liability risk for licensed operations is an important element to promote the commercial space launch industry as the government bears a portion of the risk for third-party damages and losses to government property and government personnel resulting from potential space launch accidents. In 2012, we made one recommendation for FAA to address weaknesses in that methodology, which FAA subsequently addressed.¹⁶ However, subsequent recommendations we made related to the methodology have not been addressed. In November 2015, the U.S. Commercial Space Launch Competitiveness Act (CSLCA) was enacted, which required FAA to evaluate its MPL methodology and report the results of that evaluation to two committees of Congress.¹⁷ In 2017, we reported that FAA had not updated the value the MPL assigned to a casualty—a key component of the MPL methodology—since 1988, and recommended FAA do so, which the agency has yet to address.¹⁸

In 2018, we again reported on several weaknesses in FAA's evaluation and MPL methodology and made four additional recommendations to FAA to address these

¹¹ GAO, *Commercial Space Transportation: FAA Should Examine a Range of Options to Support U.S. Launch Infrastructure*, GAO-21-154 (Washington, D.C.: Dec. 22, 2020).

¹² In May 2018, a Presidential Directive was issued that addressed both the timing and content of FAA's regulatory updates. The directive contained a deadline to publish a proposed regulation for public comment by February 1, 2019.

¹³ Streamlined Launch and Reentry License Requirements, 86 Fed. Reg. 13,448 (Mar. 9, 2021). Companies holding an active launch or reentry license at the time the final rule was issued will be considered in compliance with the rule and may continue to operate until their current license expires, for up to 5 years from the effective date of the rule. Streamlined Launch and Reentry License Requirements, 85 Fed. Reg. 79,566, 79,569 (Dec. 10, 2020).

¹⁴ In June 2021, FAA officials told us that 10 advisory circulars are undergoing internal review and that they plan to issue them in September 2021.

¹⁵ 14 C.F.R. pt 440 establishes financial responsibility and allocation of risk requirements for any launch or reentry authorized by a license or permit issued by FAA.

¹⁶ GAO, *Commercial Space Launches: FAA Should Update How It Assesses Federal Liability Risk*, GAO-12-899 (Washington, D.C., Jul. 30, 2012).

¹⁷ U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 102(b), 129 Stat. 704, 705 (2015).

¹⁸ GAO, *Commercial Space Launch Insurance: Weakness in FAA's Insurance Calculation May Expose the Federal Government to Excess Risk*, GAO-17-366 (Washington, D.C.: Mar. 23, 2017).

weaknesses.¹⁹ For example, we found that FAA had not updated or reviewed the appropriateness of the probability threshold that determines the balance of risk between launch providers and the federal government since the 1990s. As of June 2021, FAA has not yet addressed our recommendations. By not resolving these issues, FAA lacks assurance that launch companies are purchasing the appropriate amount of insurance and that the federal government is not exposed to greater liability than expected.

FAA continues to postpone its efforts to address these issues while it focuses its resources on its streamlined launch and reentry licensing rulemaking. While FAA agreed with our recommendations in 2017 and 2018, FAA officials told us in June 2021 that to fully address the recommendations they need to undertake a financial responsibility rulemaking. FAA officials said updating the financial responsibility regulations is the next new rulemaking effort they plan to begin. This approach is consistent with COMSTAC's recommendation that FAA prioritize supporting the industry's transition to, and compliance with, the streamlined launch and reentry licensing regulations first, followed by updating the regulations governing financial responsibility. FAA tasked COMSTAC with recommending improvements to the financial responsibility regulations by fall 2021.

Launch Site Operator Licensing Regulations

FAA officials told us in December 2020 that they recognize that the site operator licensing regulations,²⁰ which have been in place since 2000, need to be reviewed and potentially amended to ensure that they are appropriate for the current state of the commercial space transportation industry.²¹ We also reported at that time that industry stakeholders had differing views on FAA's existing launch site operator licensing regulations. For instance, some stakeholders told us that FAA was using its limited resources to review license applications for sites that may not be desirable to current launch providers because the proposed sites were too close to populated areas, which could result in higher MPLs and make the launches more expensive than at other sites. Other stakeholders disagreed, stating that sites with FAA-licensed operators not currently hosting launches may nonetheless be suitable for future operations, such as human transportation, depending on the market's evolution. An industry rulemaking committee convened by FAA also raised concerns that the site operator licensing regulations do not adequately consider a site's proximity to congested airspace or noise effects on communities.²²

FAA officials in June 2021 confirmed that they plan to initiate the site operator licensing rulemaking after they complete their efforts related to the streamlined launch and reentry licensing rulemaking and update the financial responsibility regulations, which aligns with COMSTAC's recommended rulemaking priorities for FAA.

Orbital Debris Mitigation Regulations

In 2013, FAA began efforts to revise its launch and reentry licensing regulations governing the steps a launch provider must take to prevent launch vehicle stages that are "expended" or discharged from the vehicle as it gains altitude and speed from generating dangerous orbital debris. FAA officials told us they put this effort on hold when they began working with other agencies to update the U.S. Government Orbital Debris Mitigation Standard Practices, which they completed in 2019. FAA officials told us they plan to align their own regulations with those practices under a separate rule to be finalized in the next few years.²³

¹⁹ GAO-18-57.

²⁰ 14 C.F.R. §§ 420, 433.

²¹ GAO-21-154.

²² In December 2020, we reviewed issues related to space transportation infrastructure and made a recommendation that FAA should examine a range of potential options to support space transportation infrastructure and that this examination include a discussion of trade-offs. GAO-21-154.

²³ While FAA regulates the mitigation of orbital debris for launch vehicles and intact re-entry, many stakeholders have recently raised concerns about potential orbital debris from growing constellations of small satellites and that the U.S. approach to tracking increasing numbers of satellites and other space objects is limited in its ability to address current and future risks, such as catastrophic collisions. For instance, while 52 small satellites were launched globally in 2012, 389 were launched in 2019, increasing the potential of a satellite to collide with another space object and create debris. The Federal Communications Commission and the National Oceanic Atmospheric Administration also possess regulatory authority to mitigate such debris for non-government entities.

FAA FACES ONGOING CHALLENGES REGULATING AN EVOLVING INDUSTRY

Compliance Oversight and Enforcement Approaches

Industry growth may present challenges to AST's approach to overseeing compliance and enforcement. AST oversees launch and reentry operators' compliance with applicable laws, including licensing regulations, and the terms of the license or permit. It does so mainly through safety inspections before, during, and after FAA-regulated operations that can impact public safety and the safety of property. In 2015, FAA shifted its agency-wide enforcement policy to emphasize collaboration with industry participants and use of compliance actions, such as counseling or training, to address violations.²⁴ AST is also party to a 2000 memorandum of agreement with the National Transportation and Safety Board and a 2021 memorandum of agreement with NASA, both covering issues related to public and human spaceflight safety for commercial space transportation activities, including efforts in accident investigations. In light of the growing number and diversification of launch and reentry operations and locations, AST's approach to overseeing compliance and enforcement may warrant review.²⁵ We plan to begin a requested review of safety oversight of commercial space activities later in 2021.

Regulation of Safety for Human Spaceflight Participants

As we previously reported, FAA continues to face the challenge of whether and when to regulate the safety of crew and spaceflight participants, such as space tourists.²⁶ While several companies have announced plans to take tourists to space within the next several years, FAA is prohibited by law from regulating crew and passenger safety before 2023, except in response to events that either caused a serious or fatal injury or contributed to an unplanned event during a commercial human space flight that posed a high risk of causing a serious or fatal injury.²⁷ To date, one fatal accident occurred in 2014 involving a crew member of a spaceflight undertaken by a private company and licensed by FAA. According to FAA officials, FAA could promulgate regulations if such an event occurred, but under the moratorium, it would be limited to the design feature that caused the accident.

FAA is required to periodically report to specified congressional committees on metrics that could indicate FAA's and the industry's readiness to transition to a safety framework that may include regulating crew, government astronauts, and spaceflight participant safety.²⁸ In the most recent report, submitted to Congress in February 2019, FAA concluded that no commercial human spaceflight activities had advanced to a stage that would necessitate a new safety framework. FAA's next and final report is due by March 2022.

FAA has taken some other steps in anticipation of the expiration of the moratorium. For example, in 2014, FAA published a document providing a compilation of performance-based recommended practices for commercial human spaceflight. FAA also tasked COMSTAC to formulate human spaceflight best practices to guide the industry. In September 2020, COMSTAC determined that published voluntary standards for commercial human spaceflight safety were in minimal use by the U.S. commercial industry and that the development of such standards, as in other industries, has been slow. COMSTAC recommended FAA evaluate several of the standards as potential inputs to future regulations and guidance. COMSTAC also recommended that FAA form an industry rulemaking committee to help focus industry efforts on voluntary standards development, apply relevant lessons learned, and to inform future spaceflight safety regulations. In June 2021, FAA officials told us that they plan to implement COMSTAC's recommendations when they begin their rulemaking effort assuming the moratorium expires.

²⁴ FAA also continues to use more punitive enforcement actions, including assessing civil penalties and suspending a person's or entity's certificate, when it finds that a commercial space operator is not in compliance with statutory or regulatory requirements. We have previously reported on issues related to FAA's enforcement policy. See GAO, *Aviation Safety: Actions Needed to Evaluate Changes to FAA's Enforcement Policy on Safety Standards*, GAO-20-642 (Washington, D.C.: Aug. 18, 2020).

²⁵ For example, in December 2020, a commercial launch provider launched an uncrewed spacecraft for a test flight from its private site after AST denied the company a safety waiver that would have allowed it to exceed the maximum public risk allowed by regulations. Shortly after landing, the launch vehicle exploded, with damage limited to the test site.

²⁶ GAO-07-16; GAO-15-706; and GAO, *Commercial Space: Industry Developments and FAA Challenges*, GAO-16-765T (Washington, D.C.: Jun. 22, 2016).

²⁷ 51 U.S.C. § 50905(c)(2)(C)-(D). This moratorium was established in statute in 2004 and set to expire in 2012, to allow the industry grow. The U.S. Commercial Space Launch Competitiveness Act, enacted in November 2015, extended the moratorium to October 1, 2023. Pub. L. No. 114-90, § 111, 129 Stat. at 709-11.

²⁸ 51 U.S.C. § 50905 (c)(6)-(7).

FAA HAS TAKEN SOME ACTIONS TO KEEP PACE WITH INDUSTRY

AST Is Improving Its Workforce Planning to Meet Its Own and Industry's Evolving Needs

AST has made strides in more strategically aligning its workforce with evolving industry demands. With the anticipated continued growth and development of new technologies and types of launches and supporting infrastructure, it is vital that AST ensure that the size, composition, and skills of its workforce are aligned with its projected workload, both the amount and type of work. In response to a recommendation we made in 2015, AST took steps to better understand how it uses its staff resources, including developing indicators for workload activities, such as inspections and consultations with potential applicants, in addition to the number of launches licensed.²⁹

AST has taken additional steps to more strategically plan for its future workforce needs since 2015, including some in response to four recommendations we made in 2019.³⁰ For example:

- AST recently assessed the workforce to identify skills and competencies that are currently needed among its workforce as well as specific competency areas that may be needed in the future to meet AST's growing and evolving workload, which addressed one of our recommendations. Using that information, AST officials told us that they developed strategies to address skill gaps, which include training and development for its current workforce, and enhancing collaboration with other FAA offices and the space industry to gain insight into the latest advances and changes in commercial space transportation.
- Since 2015, AST also has improved its workload projections to better account for the full range of its regulatory activities and the timeline of its licensing process. In June 2021, officials told us that they extended their current 2-year workload projections out to 5-years, to better anticipate and respond to emerging workforce needs. Officials also told us that by summer of 2021, they plan to finalize a more robust set of metrics for the entire office's workload to help AST determine its appropriate workforce size and composition, which would address an additional recommendation.

While AST has taken steps to strategically plan for its future workforce needs, continuing its efforts to strategically plan for its workforce needs will help position FAA to meet the needs of the evolving industry.

FAA is Taking Interim Steps to Reduce Inefficiencies in the National Airspace System, but Full Integration Is Still Years Away

The continuing growth in the number of launches places a premium on FAA's ability to safely and efficiently integrate commercial space users into the National Airspace System. However, we reported in 2019, that both FAA officials and selected industry stakeholders said FAA's current approach is inefficient.³¹ FAA officials, for example, told us in 2019 that when a space launch occurs, they have closed the airspace in the surrounding area to commercial airlines and other airspace users for longer than may have been needed and included a larger area of airspace to ensure public safety. The resulting inefficiencies have included flight delays for airlines and difficulties for launch providers to secure launch windows—the period of time in which the launch or reentry is expected to occur.

Since our 2019 report, FAA has made progress in its development of procedures, technologies, and industry coordination that are designed to reduce some of the inefficiencies experienced to date. For example:

- In May 2020, FAA updated its prior 2014 Concept of Operations for commercial space integration. The 2020 update describes the document as a high-level, long-term vision to help guide FAA in integrating space launches into the National Airspace System.
- FAA reported that in October 2020, it began using data-driven air traffic control procedures for Atlantic Route air traffic around Cape Canaveral, Florida, where more than 80 percent of the 2020 FAA-licensed launches from U.S. launch sites occurred. According to FAA officials, these procedures help air traffic control coordinate when to implement and release the airspace closure to other uses, ultimately reducing aircraft delays and reroutes caused by space launches.
- In June 2021, FAA officials told us they the agency plans to begin implementing a technology that it developed called the Space Data Integrator, which is able to receive real-time data on a launch vehicle's position and movement to im-

²⁹ GAO-15-706.

³⁰ GAO-19-437.

³¹ GAO-19-437.

prove situational awareness of launch activities in the airspace. FAA officials told us other technologies planned for implementation in the coming years may enable air traffic control to calculate a dynamic hazard area for a launch, rather than the static hazard areas that result in larger, longer airspace closures.

- FAA officials told us that in summer 2021, they plan to stand up its first of a planned series of collaborative decision-making committees to establish a forum in which commercial space, aviation, and airport representatives can work together to improve how commercial space transportation activities are integrated into the National Airspace System. The first committee will focus on data-sharing, including how to standardize and formalize data and make it available to more airspace users.

The progress FAA has made is promising, but full and efficient integration of all users of the National Airspace System is years away and will require continued work and focus.

FAA Has a Dual Role of Industry Promotion and Safety

The industry's evolution, particularly with respect to the rise in space tourism, may require a reexamination of FAA's dual role of overseeing the safety of commercial space launches while also promoting the industry. In 2006 and 2009, we stated that FAA's dual role could give rise to a potential conflict of interest as the space tourism sector develops, but found no evidence that FAA's promotional activities—such as sponsoring an annual industry conference and publishing industry studies—conflicted with its safety regulatory role at that time.³² A 2008 statutorily required DOT-commissioned report similarly concluded that there was no compelling reason to remove FAA's promotional role in the near term (through 2012), but recommended that DOT periodically review its dual role specifically for safety and promotion of human space flight.³³ We again emphasized in 2009 that FAA and Congress must remain vigilant that an inappropriate relationship between FAA and the commercial space launch industry does not occur.

In June 2021, FAA officials told us that while they agree that a reassessment may be appropriate in time, they do not think such an assessment is currently warranted. They also explained that promoting the industry was in their view related to their role in ensuring that industry participants understand relevant regulatory requirements and that FAA takes regulatory and other actions consistent with the still-developing nature of the industry. Nonetheless, given that 13 years have passed since DOT last examined its dual role and that the moratorium on DOT regulating the safety of crew and spaceflight participants is due to expire in 2023, a reexamination of DOT's dual role may be warranted as the industry continues to evolve.

Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee, this completes my prepared remarks. I would be pleased to respond to any questions that you or other Members of the Subcommittee may have at this time.

GAO CONTACT AND STAFF ACKNOWLEDGMENTS

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Mr. LARSEN. Thank you, Ms. Krause. I appreciate that very much.

And now we will turn to Member questions for panel 1. And with that, the Chair recognizes the chair of the full committee, Mr. DeFazio from Oregon.

Mr. DEFAZIO. I thank the gentleman.

Mr. Monteith, and I mentioned it in my opening remarks, we had heard, I think, first at a hearing in 2016 about the development of the Space Data Integrator. It is now 2021. And yet, the officials have told the GAO that they still plan to begin implementing this technology.

³² GAO-07-16 and GAO, *Commercial Space Transportation: Development of the Commercial Space Launch Industry Presents Safety Oversight Challenges for FAA and Raises Issues Affecting Federal Roles*, GAO-10-286T (Washington, D.C.: Dec. 2, 2009).

³³ Commercial Space Launch Amendments Act of 2004, Pub. L. No. 108-492, § 3, 118 Stat. 3974, 3982.

Can you give me a timeline for where this is in development, and when we can expect it?

Mr. MONTEITH. Sure, I can give you a little bit of an overview of it, but not a specific timeframe.

One of the things that I did when I joined the FAA a little over 2 years ago was took this program, which had been developed by my organization, and had not made a whole lot of progress, and asked our Chief Operating Officer, Teri Bristol, to take this task on.

She has, and we have seen tremendous growth or progress in the development of the system, so much so that we expect in the next few months to have the first operational test of it.

Now, the system has been operating in a shadow mode, and we expect, like I said, in the next few months, to have the first operational test, and we will be taking live data, ingesting it into our system, with the goal of reducing the airspace that must be segregated, and really integrate commercial space into the system.

Mr. DEFAZIO. OK. I think that is absolutely critical as we are going to have more and more launches, and we don't want to be diverting and delaying flights for people who can't afford \$500,000 for a ticket.

And, Ms. Krause, as I mentioned at the beginning, I stripped away FAA's dual mandate for commercial aircraft. Unfortunately, it took a horrible tragedy for people to admit that it was a problem and accept my amendment. And you did state that a reexamination dual role may be warranted as the industry continues to evolve.

Could you just elaborate a little bit on why you think we need to reexamine?

Ms. KRAUSE. Yes. The last review, as I mentioned in my opening statement, was in 2008, where DOT concluded that there was no compelling reason to remove the promotional role from FAA through 2012. It also—that report recommended that they periodically review the promotional role and safety role, particularly as it relates to human spaceflight. And, so, given the time that has passed since that review and developments in the industry, as well as the moratorium expiring, another review may be warranted.

Mr. DEFAZIO. OK. And the FAA hasn't revisited this in that interim period?

Ms. KRAUSE. Not that I am aware of, no.

Mr. DEFAZIO. OK. Is that correct, Mr. Monteith, that you haven't revisited this as was recommended that you should periodically look at it?

Mr. MONTEITH. Sir, I don't believe we have formally revisited it, but we do pay attention to this.

Mr. DEFAZIO. Uh-huh.

Mr. MONTEITH. We look at our "encourage, facilitate, promote." Everything is based on safety, safety standards, and cooperation and coordination with the industry. And we don't really do promotion in the form of marketing.

Mr. DEFAZIO. Yes. But the concern is, like when the FAA starts talking about Boeing as a customer, and we find undue influence over the inspectors, and we find managers overruling people who found critical problems with the MAX and subsequently people died.

It is a creep that can happen. And it is just—you know, they are not customers. The commercial aviation industry is a regulated entity, and we will have to be watching commercial space very closely.

And, finally, the chair and I wrote a letter on March 25 regarding the SpaceX launching without authorization. What has SpaceX done to deal with the operational concerns you had, and, essentially, the cultural issues that you flagged? Are you satisfied that they are now fully compliant and they are cleaning things up?

Mr. MONTEITH. Yes, sir, I am. And we would not have cleared them to start flight operations again, had I not been confident that they had modified their procedures effectively and addressed the safety culture issues that we saw during the events of Starship Serial No. 8 or SN8.

Mr. DEFAZIO. OK. Thank you.

Thank you, Mr. Chairman.

Mr. LARSEN. The Chair recognizes Mr. Graves of Louisiana for 5 minutes.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman.

General Monteith, for several years now, Congress has had a lot of discussion about which civil agency should be responsible for the provision of space situational awareness services. We haven't come to a decision yet, and I am curious of your thoughts in response, and if you think the FAA would be able to execute that mission if Congress decided that it should be a responsibility?

Mr. MONTEITH. Sure. Great question.

From my perspective, the most important thing is that whichever civil agency is tasked with this responsibility, it is done right, and so that likely means that a change in statute and a sufficient budget to get the job done. If Congress were to decide that this is a responsibility for the Department of Transportation, I am confident that the FAA would step up to the plate and we could accomplish the mission.

Mr. GRAVES OF LOUISIANA. Thank you.

Another question for you. Another concern we have, as I covered in the opening statement, was the reentry of space debris. If that mission—and then, of course, the impact on airspace and aircraft—if that mission were ultimately given to the FAA, do you think that AST and the Air Traffic Organization would be capable of working together to accomplish that mission, or administer it?

Mr. MONTEITH. Sir, if Congress did task us with that mission, I am confident that while it is difficult, that with the appropriate authorization and appropriation, we would get it done. And I can tell you the relationship that we have with the Air Traffic Organization, there is no daylight between Teri Bristol and I on how we consider the safety of the NAS and integrating commercial space into the NAS. We are full partners with the Air Traffic Organization.

Mr. GRAVES OF LOUISIANA. Thank you.

With the bulk of part 450 rulemaking behind us, there are a lot of other commercial space transportation regulations that may need similar revisiting, may be outdated or overly burdensome.

Are there any of them that come to mind for you in terms of ones that you think deserve revisiting or would be a priority?

Mr. MONTEITH. Sir, we are evaluating that. As I mentioned in my opening statement, we are ready to press forward with the orbital debris rule, which really concerns upper stages and debris coming off of upper stages. Secondly, we want to take a real hard look at part 440, financial responsibility, as recommended by COMSTAC. And then we also know that we do need to look at our spaceport regulations, which really have not kept up with the state of the industry.

But as a regulator, I think it is important for us to continually look at these and not wait 20 years to repromulgate a regulation that has grown stale.

Mr. GRAVES OF LOUISIANA. Thank you.

As you know, in 2018, the committee provided the Secretary with the authority to create aerospace rulemaking committees. Will the FAA consider asking the Secretary to convene an ARC for commercial space transportation rulemakings to help the FAA develop proposed rules?

Mr. MONTEITH. In a word sir, yes. I think it is critical that we have full industry involvement as we develop these regulations, and a full public comment period so we can have the best, most effective, and efficient regulations that we can possibly develop.

Mr. GRAVES OF LOUISIANA. Thanks.

Last one for you, General, and I appreciate your answers.

As I covered in my opening statement, there has been—during the commercial human spaceflight learning period, industry is supposed to be working towards sort of a consensus on safety standards. As I said, the momentum appears to be moving in the right direction.

Where do you think the focus over the next 24 months or so should be for those efforts?

Mr. MONTEITH. Sir, you know, I understand why the learning period was established when it was; but as was previously mentioned, with three companies likely flying commercial spaceflight participants this year, and a fourth next year, I think the landscape is changing, and I think it is important that we relook at some of those restrictions or, in this case, the moratorium.

I also think that even with no change there, we still need to continue pressing forward to develop those consensus standards and to refresh our guidelines for commercial human spaceflight.

Mr. GRAVES OF LOUISIANA. Thank you.

I yield back.

Mr. LARSEN. Thank you, Mr. Graves.

I now recognize myself for 5 minutes, and the first question is for Ms. Krause.

The FAA has taken steps to reduce inefficiencies in the NAS. In your testimony, you say this progress is promising but full integration is years away. In your opinion, has the progress made by FAA been sufficient? And what are the hurdles to that?

Ms. KRAUSE. Back in 2019, we had done a review looking at integration efforts and certainly heard from both industry and FAA an acknowledgment that their current approach was creating inefficiencies. I think since we have done that work, FAA has taken a number of steps, both on the procedural and developing technologies, as well as starting to work through some bodies to do ad-

ditional industry coordination, and those are what I mean in terms of “promising.” Those are the types of things that are needed to really get us closer and move towards more full integration in the NAS.

Mr. LARSEN. So the FAA has given you a date of this summer, I guess, which is just a few days away, to stand up the first of a series of committees to establish a forum for integration of the NAS with commercial space activities. What is an appropriate timeline for other needed committees or activities in this area?

Ms. KRAUSE. That is a timeline that would have to be worked closely with both FAA and sort of the industry in figuring out all of the different components that need to come together. It is a complex issue to work through, and technologies and systems need to be further developed so that there is better data to be able to assess risk and look at opportunities to further create efficiencies as well as safely integrating different aircraft in the NAS.

Mr. LARSEN. And then as well, can you be clearer—it is in your written testimony, I wasn’t quite sure from your oral testimony, about the FAA’s role prior to 2023 in looking at the safety of crew and spaceflight participants? Should they get some work done now in the event of action? Are they not allowed to take action before then? Can you be clearer about that?

Ms. KRAUSE. Sure, absolutely.

I think the regulations allow them to respond to issues where if there is an accident or a mishap, they can look at the issue of the design that caused that. There are also things that the FAA can do and is doing in terms of working with industry to develop best practices that they can disseminate amongst the industry as well as was discussed, consensus standards, that I think will really help inform where things might head should the moratorium expire.

Mr. LARSEN. Thank you.

Mr. Monteith, the FAA is responsible for clearing the NAS for military and other Government launches. Is there anything different you are expecting with commercial launches in terms of either process or—I guess, mainly process? Are there lessons to be learned from that that will be applied specifically to commercial launches?

Mr. MONTEITH. Yes, sir, there will. And it will actually be—it can be applied in both directions. And even though Space Data Integrator is just getting ready to do the first operational test, the Air Traffic Organization has already been leaning forward and implementing concepts like time-based launch procedures. We know there are specific events during a launch countdown that trigger timelines to launch.

Using that information, the ATO can adjust the airspace that is restricted and reduce the amount of restricted airspace and the time that it is actually restricted.

Mr. LARSEN. Thank you.

Before I turn to Mr. Perry, I just want to let folks know we are supposed to have our first votes between 2:40 and 2:50, or something along those lines, and there are going to be several votes. I am still trying to determine whether we should just plow through this or recess; but when I decide, I will let you know.

So with that, I will turn to Mr. Perry for 5 minutes from Pennsylvania.

Mr. PERRY. I thank the chairman.

Mr. Monteith, the Biden administration has requested a nearly \$5 million increase in the budget for the operations account of the Office of Commercial Space Transportation. What is your plan to prioritize these funds towards licensing efforts to ensure that the office is in compliance with the statutory time limits for launch licensing in the Commercial Space Launch Act?

Mr. MONTEITH. Sir, I appreciate the question.

We have taken a look at every function that we have in the office to maximize our efficiency and effectiveness. We are hiring to our full authorized level this year. For the first time in the history of the office, we have actually been able to sustain over 100 full-time employees, and our efforts are geared primarily toward that licensing effort.

We have been very successful thus far, but as we have identified earlier, just since this time last year, our launch cadence has doubled in just 1 year, and, so, we have got a lot of work ahead of us, and we are being proactive, as proactive as we can, to lead turn this problem so we do not become the impediment to industry.

Mr. PERRY. Well, then on—yes, just stay with me here.

On a similar note, what efforts have you taken to date to ensure compliance with the statutory requirements related to timely and responsive license review and approvals? And what are the office's future plans to improve timeliness and responsiveness?

Mr. MONTEITH. Sir, if I understand the question correctly, it is a 180-day statutory requirement to have a license evaluated once it is determined to be complete. And I can only think of currently, I believe, one license where that did not occur, and that had to do with the environmental review process.

Mr. PERRY. OK. All right.

And continuing on, the Trump administration required the Department of Transportation to rewrite the launch and reentry rules after nearly two decades of almost no modification. The industry is moving quickly and innovating at a speed to which the Federal Government, quite honestly, is probably unaccustomed, including developing unique and untraditional launch systems.

How is the FAA working with the industry to ensure that the new part 450 will accommodate innovation and advancement without hindering the industry?

Mr. MONTEITH. Thank you, sir.

First and foremost, part 450 was written to be performance-based as opposed to prescriptive, which it was in the past, which really put a damper on innovation. We have worked with industry on part 450. The feedback we have gotten from industry, we have got a full 3-day workshop on the new 450 itself, got very positive feedback, and that workshop was with industry. We have also done the same thing, a 1-day workshop with the international partners, and we are working with industry as we develop—right now, it is 27 advisory circulars that will help guide them through and provide a means of compliance for specific parts of part 450.

Mr. PERRY. So, in keeping kind of with that theme, what do you think needs to be done to facilitate further mutually beneficial co-

operation between the agency and industry? Do you feel that there are any barriers hindering those efforts?

Mr. MONTEITH. Sir, I don't believe there are barriers. We have open and honest communication with our industry partners, and the industry companies know that I am always available to take their calls and talk to them and discuss any concerns they have about either the way we conduct business or the regulatory way ahead.

Mr. PERRY. Well, sir, thank you for your service. I notice that you commanded the 45th Space Wing in Florida. During your time there, you oversaw the very first rocket landing, which has since occurred more than 80 times. A reusable rocket, as well as other industry-led innovative technologies and launch systems, continue to drive down the cost of space access delivering tangible benefits to the American consumer, the economy, and our national security.

Give me a background. Can you elaborate in the short time we have left on the importance of these innovations in supporting our national security and economic circumstances?

Mr. MONTEITH. Sir, if we want to stay the world leader in this transportation sector, innovation is critical, just like STEM is, and diversity is as well. I oversaw the first 23 booster landings, and I can tell you personally it is a game changer.

Mr. PERRY. Well, thank you.

And I yield back the balance of my time.

Mr. LARSEN. Thank you, Representative Perry.

The Chair now recognizes Representative Payne from New Jersey for 5 minutes.

Representative Payne.

Mr. PAYNE. Mr. Chairman, if I could yield and come back at a later time?

Mr. LARSEN. All right. It is possible, but you might want to take this opportunity now just in terms of—if not, we will go to Mr. Brown.

All right. We will go to Mr. Brown from Maryland for 5 minutes.

Mr. Brown?

You are on mute, Mr. Brown.

Representative Brown, you are on mute.

[Pause.]

OK. Representative Payne, you have 5 minutes right now if you want them.

Mr. PAYNE. Thank you, Mr. Chairman.

First of all, let me thank you for having this hearing and I wanted to ask—can you hear me?

Mr. LARSEN. You are good, you are good.

Mr. PAYNE. I am sorry.

Mr. Monteith, commercial space exploration is the next frontier of American discovery, but it is our responsibility to ensure that it is conducted with safety at the forefront. FAA and NASA have regulations and norms developed over decades to ensure safe and orderly operations. Commercial spaceflight is the only sector in its second decade of operations, and we must make sure that this safety culture can overcome the move-fast-and-break-things mantra of startups.

Based on the FAA and NASA approach to safety, how do we instill those values in the commercial space transportation?

Mr. MONTEITH. Sir, that is a great question.

And from my perspective, these companies, while they are trying to go quick, they are safe. At the heart of their business, they are concerned about safety. If we get any inkling that they are not concerned about safety, that is when we step in.

The FAA has licensed 404 launches, commercial launches since our inception, and we have never had a fatality or casualty or serious injury to the uninvolved public. And that doesn't mean things haven't gone wrong. About 15 percent of our flights we declare a mishap; in other words, something didn't quite go wrong. Some of them, sometimes it is an engine that is not working quite right. Sometimes it is very spectacular that you will see across the internet. But what every single one of those mishaps has in common is they failed safely and nobody was injured.

So safety, as my Administrator says, is our North Star, and we stay laser focused, my entire team, on the safety of what is inherently a dangerous operation every single day, sir.

Mr. PAYNE. I, like other members on this committee, represent a district that contains a major airport. How does the FAA plan to deal with an increasing number of space launches to avoid major service disruptions and safety concerns related to air travel?

Mr. MONTEITH. Yes, sir. We work hand in hand with our counterparts, and I meet personally with my peers, both the Chief Operating Officer and the head of airports, as we work through these. We also have our teams. Anytime a license application or a concept for a launch operator comes in, we work throughout that entire process with our counterparts within the FAA to make sure that, to the extent that we can, that these operations are integrated and at the foundation, they are always, always, always safe.

So, for instance, you would not expect to see an operation, say, in the middle of the country that is launching Saturn V-type rockets.

Mr. PAYNE. All right.

Mr. MONTEITH. Because we are working together to ensure that that doesn't happen.

Mr. PAYNE. Excellent.

Ms. Krause, to develop eventual regulation of commercial space transportation, Federal agencies will need relevant information and studies of pertinent issues. What areas in commercial space transportation need further investigation and evaluation? And how can Congress help in these efforts?

Ms. KRAUSE. Thanks for the question.

One area we have looked at in the past is FAA's workforce and AST's efforts to make sure that they have the skills in place. That is an area to continue to have attention on, and I know FAA continues to evolve and monitor and kind of ongoing analysis of how their workforce is ready. So, that is something to really pay attention to, because you need the skills in place in order to carry out, respond to, and adapt to changes in the industry.

I also mentioned it may warrant another review of the dual mandate as the industry develops, and particularly as the human spaceflight industry continues to develop.

Mr. PAYNE. Thank you.

And, Mr. Chairman, thank you for your patience, and I yield back.

Mr. LARSEN. Thank you, Representative Payne.

We are going to try to keep going here, and if Representative Steel is available for questions.

Representative Steel?

[Pause.]

And Representative Balderson. Is Representative Balderson available?

[Pause.]

All right. I am going to ask the ranking member unanimous consent—we do have a few folks on this side of the aisle who are here for questions, can I get them started? I know it is out of order. So that is an OK from the ranking member?

So I will go with Mr. Kahele.

Mr. KAHELE. Thank you, Mr. Chair, and to our witnesses today for participating in this very important conversation.

I guess my question would be for Mr. Monteith. Similar to the previous question, maybe mine will touch more on the regulatory framework. On page 6 in your testimony, you described commercial space operations as currently being treated as a special case in which air traffic controllers block off large sections of airspace for extended periods of time for a single launch.

As the number of commercial space operation grows exponentially, maybe explain a little differently than your previous explanation about the next steps for the FAA in terms of the regulatory framework. I know from your testimony, 14 CFR part 450 was adopted. But how do you see the integration of commercial spaceflight and the regulatory aspect of it and that evolution, to integrate it into the National Airspace System?

When I look at this, I think of the challenges that we had and still have in integrating unmanned aircraft systems into the National Airspace System. So could you discuss a little bit of your thoughts on that aspect?

Mr. MONTEITH. Yes, sir. And I appreciate the question.

As I stated in my oral testimony, integration of commercial space into the NAS is a top priority for the FAA, and with the development of the Space Data Integrator, it is more about technology and capability than it is about a new regulatory framework.

As we started this journey, the amount of time it took between when we realized a rocket had a mishap or a catastrophic anomaly, to when we could actually get commands to the flight deck, took historically 14 to 18 minutes, which is why we had to separate, or segregate, the very large swath of airspace for a significant amount of time.

When SDI is completely implemented, right now the goal is, because we are using a machine to a machine as opposed to manual inputs, that goal will be less than 1 minute which really, at that point, gets you to where you are truly integrating the airspace for these complementary operations.

Mr. KAHELE. What do you think, as the commercial space operations and industry grows, obviously, there are more preferred and desired locations for space launches, typically Florida—Cape Ca-

naveral and California—Vandenberg. Are there other areas of the country that we are looking for an increase in commercial space launches, or are there areas that we can fairly say this is where it would be most highly concentrated and, therefore, affecting the commercial aircraft activity in those areas?

Mr. MONTEITH. Yes, sir. You know, there are more optimal locations to have a spaceport at. Of course, being on the coast is one because of down range debris, closer to the Equator, so you use the rotation of the Earth as an energy boost to get into geosynchronous orbit where our communication satellites are, our big ones are. So there are certainly optimal places.

Right now, we are not at capacity, but at some point with these locations that you mentioned, we will be at capacity. Right now, we currently have 12 FAA-licensed spaceports. I believe five are actively conducting launch operations, so we have seven that are still waiting for launch operators to come to their facilities.

But I see this industry is, if anything, accelerating versus going down, which I believe it will be even more critical to take a look at our spaceport infrastructure to ensure that it can handle the growth, and that we can remain a global leader in this transportation sector, sir.

Mr. KAHELE. If one of those licenses does not exist of those 12 licensees, do you—and how do you foresee Hawaii playing a role in commercial space launch future activities?

Mr. MONTEITH. Well, sir, since I grew up on Oahu, I would love to see a spaceport in Hawaii just personally, but there are opportunities, of course, all consistent with safety and our environmental regulations, that would allow us to put, particularly on areas with plenty of coast like Hawaii has, could potentially support a spaceport operation.

Mr. KAHELE. All right. Thank you so much. Mahalo.

Mr. LARSEN. Thank you.

And the Chair calls on Mr. Garamendi for 5 minutes.

I would note—just a heads-up—although there are 4 minutes and 30 seconds left in the vote, a total of 56 people total have voted.

So, Mr. Garamendi, you are recognized for 5 minutes.

Mr. GARAMENDI. Thank you, Mr. Chairman.

Two sets of questions. One is, who pays for all this, the commercial space operators or the taxpayers? I am going to let that one hang there. I don't think that the answer is going to be found in this hearing, but I think it needs to be out there. This is going to become much more expensive as more and more spaceflights occur.

Secondly, this is an issue, Mr. Chairman, that you and I may know a little bit about, or maybe we don't know enough about it. In 2018, General Hayden said that space awareness, that is, what is going on in space, space junk, space satellites, all that, could be handled by a nondefense Government agency.

More recently, in fact, it has been in the last 3 or 4—within the last 3 months, this issue has come back. And the last I heard from the military is maybe not. Maybe the Department of Defense needs to stay on top of this issue for a whole variety of reasons, many of which you and I have heard on the Armed Services Committee.

I think this issue remains unresolved, despite President Trump's 2018 directive. I would like to see more discussion about this. I would like to hear from the Department of Defense as they view this matter and the more recent Space Command and Space Force that now exists. So I am going to let it go at that.

These are two questions that are out there. If any of the witnesses have an answer, good. Otherwise, you and I are going to leave and vote.

Did I see the chairman leaving? He ran away, did he?

If either of the witnesses want to respond, who pays, and does this space situational awareness reside in the Department of Defense or Congress?

Mr. MONTEITH. Sir, having done that mission when I was in the Air Force, I can tell you, while I was in, the discussions made perfect sense that some of this could definitely be offloaded to a civil organization.

The Department of Defense will still continue to get exquisite space situational awareness data. The issue is whether or not they can ingest all of the commercially available data that is out there right now, because of the restrictions on what their systems also do from a defense perspective.

On the civil side, you can ingest all of that data and provide more accurate location of where satellites are so that you can start walking down a path where you can better have collision avoidance for these objects on orbit.

Mr. GARAMENDI. Thank you. I yield back.

Mr. STANTON [presiding]. Thank you very much.

Are there any of our GOP colleagues logged on at this point? My understanding is there is not, but I want to ask to confirm. Any Republican Members available to ask questions?

All right. If not, I will proceed with my own questions then, and this is a continuation of some questions that were asked earlier by Chairman DeFazio. These are for Associate Administrator Monteith and Ms. Krause.

Through its licensing authorities, the FAA is required to ensure and protect public health and safety, national security, and foreign policy interests of the United States. Yet, at the same time, the FAA is required to encourage, facilitate, and promote the commercial space transportation industry. And so this creates a dual mandate for the organization.

So following up on Chairman DeFazio's questions, I want to hear each of your own individual views about this dual mandate and how this dual mandate best serves or can it serve the interests of the Federal Government, commercial space launch industry, and, most importantly, the American people.

Mr. MONTEITH. Sir, if you would like me to start, what I would say—and we take both of those mandates seriously, but for me, it is an if/then. If the first is accomplished, we are able to do the second, because everything evolves around safety.

And so when we encourage and facilitate this industry, really, from my perspective, it is more about facilitation. It is ensuring that we have got the right regulations or the right scope at the right time to ensure safety, while also allowing these companies to innovate and grow and continue to lead on the global stage.

We don't do, quite frankly, a whole lot of encouraging. And for promotion, it is all about promoting safety standards and consensus standards and working with industry for that, as opposed to what would traditionally be considered potentially marketing, which we really don't do.

Mr. STANTON. Thank you.

Ms. Krause, could I get your answer on the issue of the dual mandate that is currently in place?

Ms. KRAUSE. Sure. I mean, we have previously emphasized that it is important that both FAA and Congress remain vigilant, ensuring that there is no inappropriate role between FAA and the commercial space industry. As I had mentioned earlier, the last review of looking at the dual role was back in 2008, where it concluded that there was no compelling reason to separate out the promotional role from FAA for 2012.

But, really, given the changes that there have been in the industry, as well as the moratorium expiring and the recommendation coming out of that report to periodically review this, we think that taking another look at this issue may be warranted.

Mr. STANTON. Thank you very much.

Over the last decade, there has been a steady growth in the industry in the number of launches licensed by the FAA. Just 5 years ago, there were nine launches. Last year, there was a record 39, representing a nearly 400-percent increase since 2015. This year, 39 launches have been licensed to date, and we are only midway through the year. In addition to the increase in launch licenses, the number of launch companies, especially for small satellites, is growing.

I want to ask each of you about workforce issues associated with this exponential growth in the industry. Is the FAA workforce keeping pace with this growth, and what has been the overall impact on the FAA's operations and licensing activities in light of this fast growth? And that is for either witness.

Mr. MONTEITH. Sir, so far, we have been able to keep up, but it is a challenge. I can tell you from the skill sets that we need that are mostly STEM-related, we are just one of many organizations that are looking for the same small pool of talented individuals.

Of course, you have got industry that frequently can offer more compensation. And on the Government side, while it is great and exciting to be a regulator, I have to compete against NASA, the Air Force, and now the U.S. Space Force.

But with all that said, what we offer is the ability for folks to come in and learn the entire industry. And then either they will stay with us for 20 or 30 years or potentially go to industry and take our safety foundation with them and the understanding of why regulations are important.

But as we continue to grow, I see this as becoming a greater and greater challenge for all of us if we cannot solve the problem we have with not enough folks in STEM.

Mr. STANTON. Thank you, Mr. Monteith.

Ms. Krause, any thoughts about workforce issues as it relates to the growth in this industry?

Ms. KRAUSE. Yes, that is an issue we have looked at closely and have identified some opportunities for FAA to more strategically

manage its workforce and be in a position to respond to changes in the industry. The FAA has responded to those recommendations and continues to work on them. Things like having a better sense of the time that their staff is using and what kind of time is being spent on different activities as well as the skills and competencies that are needed.

But, we are looking for FAA to really follow through on the other recommendations, which is understanding workload metrics, projections, so that they can get these people on board and trained up and ready to respond to changes in the industry.

Mr. STANTON. I want to thank both of our panelists in the first panel for your important testimony here today. Your contribution to today's discussion has been very informative and very helpful.

Because votes have been called, we have an eight-vote series right now, some of our colleagues were not able to ask questions of the first panel. So, as a result, the committee is going to stand in recess until 5 minutes after the end of the last vote series today. We hope it is around 5:15, and at that point, we will call upon the second panel.

I apologize. I have been told that my colleague, Congressman DeSaulnier, is on and ready to ask questions of our first panel. I appreciate that. And at that point, we will stand in recess.

Congressman.

Mr. DESAULNIER. I am fine, Mr. Chairman. If you want to go to recess, I can wait. Whatever is more convenient for you and the staff.

Mr. STANTON. The issue would be, if we recess, we are going to release these two witnesses.

Mr. DESAULNIER. OK.

Mr. STANTON. So if you want to ask questions of these witnesses, do it now. And then, otherwise, we can hold off till the second panel later.

Mr. DESAULNIER. I will hold off till the second panel. Thank you so much.

Mr. STANTON. Thank you, Congressman.

We stand in recess until 5 minutes after the end of the last vote.
[Recess.]

Mr. LARSEN [presiding]. I call the committee back in from recess to continue the hearing on FAA's important role, critical role in commercial space launch.

We are going to move to the second panel, and I am going to—just a heads-up. We are between a series of votes, so we have a little bit of time right now for this work, and we will go until the next round of votes is called. But we have a little bit of time. I just want to let folks know that.

So I would note that space launches can be vertical or horizontal. They are designed to meet different commercial needs, such as launching a GPS satellite into geostationary orbit or a new telescope to explore space. With that in mind, this subcommittee must consider the depth and the breadth of the industry being regulated.

Launch providers who have been in the business for some time have developed longstanding safety requirements and use existing standards, and that knowledge will be extremely helpful.

That is why I am pleased to have on this panel Mr. Salvatore Bruno, the president and CEO of ULA, or United Launch Alliance. And I look forward to hearing from Mr. Bruno about what is needed from the FAA to support effective yet efficient launch and spaceport licensing and how vital that is to the success of the industry.

Mr. Frank DiBello, president and CEO of Space Florida, is on the panel, and we will hear from him. I would like to hear from him his evaluation of the present and future of FAA launch and spaceport regulations.

Recent figures indicate that the airline industry and passenger travel are rebounding from the COVID-19 pandemic. So consequently, it is important to ask how to fully and safely integrate growing airspace operations, like commercial space launch, with existing airspace users. I am glad, therefore, to welcome Captain Joe DePete of the Air Line Pilots Association to hear that perspective.

And the perspective of new entrants into the commercial space operations field also play a key role in this discussion. I am happy to welcome Mr. Mike Moses, the president of Space Missions and Safety of Virgin Galactic, to hear their unique priorities.

So as nascent operations and technologies are integrated into the complex National Airspace System, the safety of all who fly and those on the ground remain a top priority. This Congress, this administration, the industry, and the workforce must work together to move forward as we embark on the next chapter of U.S. airspace.

And I would note, before I go to the witnesses, that this committee takes this oversight very seriously. We do not believe that we have jurisdiction over space, but you have to travel through airspace to get to space, what I like to think of as our space to get to space. And so this is why this hearing is so critically important to hear about the FAA's role and to hear about how the industry is working with the FAA and what needs to be better to ensure that the controlled airspace and the National Airspace System is controlled in a safe manner that facilitates the industry.

That was, for the record, the conclusion of my opening statement from previously. And so I want to just move now to the panelists, and the first panelist will be Mr. Bruno of United Launch Alliance.

Mr. Bruno, you are recognized for 5 minutes.

TESTIMONY OF SALVATORE T. "TORY" BRUNO, PRESIDENT AND CHIEF EXECUTIVE OFFICER, UNITED LAUNCH ALLIANCE, LLC; FRANK DIBELLO, PRESIDENT AND CHIEF EXECUTIVE OFFICER, SPACE FLORIDA; CAPTAIN JOSEPH G. DEPETE, PRESIDENT, AIR LINE PILOTS ASSOCIATION, INTERNATIONAL; AND MIKE MOSES, PRESIDENT OF SPACE MISSIONS AND SAFETY, VIRGIN GALACTIC

Mr. BRUNO. Thank you.

Chairman Larsen, Chairman DeFazio, Ranking Members Graves, and members of the subcommittee, thank you for this opportunity to speak on a matter of vital importance to our Nation: the FAA's role in promoting U.S. commercial space transportation, ensuring public safety, and protecting the national security and foreign policy interests of the United States.

I am privileged to represent United Launch Alliance's talented and dedicated team of women and men who are at the forefront of our industry. As president and CEO of ULA, it is my responsibility to be laser-focused on providing reliable, affordable, and especially safe space transportation services.

Having an unmatched record of 100 percent mission success across 144 launches for the Department of Defense, NASA, and commercial customers, ULA occupies a unique position and perspective in U.S. space transportation. Today, these missions launch on our Atlas V and Delta IV rockets, and soon, we will debut the innovative Vulcan Centaur.

U.S. leadership in space can only be maintained with an increasingly successful domestic commercial space transportation industry. That fact underscores the truly enormous importance of the FAA's licensing of launch, reentry, and spaceports, while protecting national security and public safety. It is important to recognize that safety is as much in the interest of the commercial space transportation industry as it is in the interest of the general public.

Any loss of life, damage to property, or environmental degradation caused by space launches, reentries, or spaceport activities could harm our entire industry by reducing public and political confidence, which could lead to increased restrictions and related costs. This, in turn, would have an adverse impact on the commercial space and our overall national interest, as space transportation would become more constrained and expensive.

I am happy to report that the ULA safety record remains impeccable. The recent streamlining of launch and reentry regulations is a landmark example of how the FAA has contributed to the advancement of U.S. commercial space transportation, while maintaining safety as paramount and protecting our national security and foreign policy interests.

In order to maintain the integrity of the licensing process, we need effective enforcement. It may not be obvious, but the FAA has never denied an operational launch license. If the FAA has a concern with a ULA license, they promptly let us know, and we make sure the issue is resolved well in advance of launch.

These regulations exist for a reason. Space launch is not as easy as we make it look. These are incredibly complex machines of enormous destructive potential. Industry is naturally going to trend towards pushing the boundaries, so it is vital that Congress provides FAA the support it needs to conduct effective oversight and enforcement of the licensing process. Responsible operators will comply with FAA regulations and licenses. Those who do not should face enforcement and impactful consequences.

Other issues the FAA will play a role in addressing include human spaceflight safety, the integration of the National Airspace System, the protection of the orbital regime, and the protection of air traffic from an increase in reentering space debris. I address these topics further in my written testimony.

In closing, I wish to express my appreciation for your focus on the FAA and U.S. commercial space transportation. Your dedicated attention to this vitally important matter is indispensable to ensuring the continued support of Congress for the FAA and our industry.

Again, thank you for inviting me to testify today. I look forward to answering all of your questions.

[Mr. Bruno's prepared statement follows:]

**Prepared Statement of Salvatore T. "Tory" Bruno, President and Chief
Executive Officer, United Launch Alliance, LLC**

INTRODUCTION

Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee—thank you for this opportunity to speak on a matter of vital importance to our nation—the Federal Aviation Administration's (FAA) role in promoting U.S. commercial space transportation, ensuring public safety, and protecting the national security and foreign policy interests of the United States. I am privileged to represent United Launch Alliance's (ULA) talented and dedicated team of women and men, who are at the forefront of our industry. As President and CEO of ULA, it is my responsibility to be laser-focused on providing reliable, affordable, and safe space transportation services.

To develop our launchers and deliver payloads to space, ULA maintains major assets across the United States. We staff employees at facilities in Denver and Pueblo, Colorado, Decatur, Alabama, and Harlingen, Texas where we conduct sophisticated launch vehicle engineering, testing, manufacturing, assembly, and integration. At Cape Canaveral Space Force Station in Florida and Vandenberg Space Force Base in California, we conduct payload integration and launch operations. I am extremely proud of ULA's dedicated workforce. Many of our employees are represented by the International Association of Machinists and Aerospace Workers and the United Automobile, Aerospace and Agricultural Implement Workers of America.

ULA also partners with thousands of suppliers across the country in nearly every state. By working with these suppliers—many of which are small businesses—ULA plays a critical role in assuring a highly productive and competitive U.S. space industrial base.

ULA'S SUPPLIERS ACROSS THE NATION



MISSION SUCCESS

Having an unmatched record of 100 percent mission success across 144 launches for the Department of Defense, NASA, and commercial customers, ULA occupies a unique position in U.S. space transportation. Since its formation in 2006, ULA has launched satellites for GPS, communications, weather forecasting, Earth science, planetary exploration, missile warning, and intelligence, among other purposes that are critically important to our nation. Today, these missions launch on our Atlas V and Delta IV rockets, and soon we will debut the innovative Vulcan Centaur.



ULA remains the only launch provider capable of meeting all national security launch needs. For many years, the Department of Defense has entrusted ULA with delivering its most important national security payloads to space. The United States Space Force's recent selection of ULA as the nation's "best value" provider, chosen to launch 60 percent of all national security payloads from 2022–2027, reaffirms ULA's trusted position.

ULA's Atlas, Delta, and heritage rockets have enabled NASA science missions to travel to every planet in the Solar System, the Sun, and beyond. In 1962, when John Glenn became the first U.S. astronaut to orbit the Earth, he rode aboard an Atlas rocket. Today, ULA's rockets send cargo to the International Space Station as part of the Commercial Cargo program and will soon carry our American astronauts there aboard Starliner as part of the Commercial Crew program. It is worth noting that launches in support of Commercial Cargo and Commercial Crew are FAA licensed launches.

Every single successful U.S. mission to Mars has arrived safely thanks to a ride from ULA's Atlas, Delta, and heritage rockets. With the benefit of ULA's launch services, NASA's *Perseverance* and *Ingenuity* are achieving major technical breakthroughs and making exciting new discoveries on Mars. In doing so, NASA is inspiring America's youth to pursue science, technology, engineering, and math—collectively known as STEM—and demonstrating that the United States remains the global leader of space exploration, outpacing China's aggressive space program, which is a major component of the Chinese Communist Party's ambition to supplant U.S. global leadership and replace democracy with authoritarianism as the global model for governance.

144 SUCCESSFUL LAUNCHES AND COUNTING



ULA has many commercial customers who rely on ULA to successfully place satellites in orbit. These commercial launches represent major investments and business opportunities that yield essential services and generate economic growth, as well as augment capabilities of our dedicated national security and civil space assets. Our upcoming launches will support numerous commercial customers serving various markets. ULA's upcoming first flight of Vulcan Centaur will carry the first American commercial vehicle to the lunar surface as part of NASA's Commercial Lunar Payload Services (CLPS) program. In addition to science payloads, the vehicle will carry the STEM projects of American and international students.

As Vulcan nears operation, ULA is beginning the transition from Atlas V and Delta IV. Vulcan incorporates important technical innovations—many tested on our existing vehicles to optimize development—which enables ULA to meet its goal of offering launches at a significantly lower cost, while maintaining maximum reliability, thereby expanding opportunities for the commercial development of space. More than thirty Vulcan launches are already on our launch manifest.

COMMERCIAL SPACE LAUNCH LICENSING

Though sometimes overlooked, the success of U.S. commercial space transportation has become integral to that of our civil and national security space programs. In a geopolitical environment characterized by a renewed competition for global power, the United States cannot afford to relinquish its leadership position in space. That leadership can only be maintained with an increasingly successful domestic space transportation industry. That fact underscores the enormous importance of the FAA's licensing of launch, reentry, and spaceports, while protecting national security and public safety.

When conducting space launches for commercial customers, ULA seeks a license from the FAA's Office of Commercial Space Transportation (AST). The Atlas V and Delta IV rockets were both commercially developed in the late 1990s to rely on a burgeoning commercial market. In fact, at the time it was assumed U.S. government launches would make up a tiny minority of the launch manifest. Because of this, our launch operators are experts on the licensing process. When the FAA began work on a major update to the licensing process in 2018, ULA played an integral role in providing industry feedback on how to streamline existing rules in a way that would ignite the commercial launch industry while maintaining safety as the number one priority of the agency.

The future success of the U.S. commercial space transportation industry depends upon the efficiency and effectiveness of FAA licensing. I applaud the organization for rising to the challenge by finding ways to reduce regulatory burdens and their attendant costs, in addition to assigning the highest priority to safety and protecting national interests.

It is important to recognize that safety is as much in the interest of the commercial space transportation industry as it is in the interest of the general public. Any loss of life, damage to property, or environmental degradation caused by space launches, reentries, or spaceport activities could harm our entire industry by reducing public and political confidence, which would lead to increased restrictions and

related costs. This, in turn, would have an adverse impact on commercial space and our overall national interest as space transportation becomes more constrained and expensive. I am happy to report that the ULA safety record remains impeccable.

The success of our industry can be clearly measured by the increase in licensed space operations. In 2011, there was only one licensed commercial space launch, while in 2020 that number grew to 39. Beyond evincing our industry's success, this measure emphasizes the need for regulators to adapt. The FAA responded boldly to the need for a constructive, forward-leaning approach to the escalating demand for launch and reentry licenses. The organization's streamlining of launch and reentry regulations is a landmark example of how the FAA has contributed to the advancement of U.S. commercial space transportation, while maintaining safety as paramount, and protecting our national security and foreign policy interests. This followed reorganizing FAA/AST along functional lines to increase accountability, retool internal processes for effectiveness and efficiency, and hire additional staff with the right skills to meet future demands.

In a world marked by economic competition, changing climate, health emergencies, and international political, military, and intelligence challenges, the new FAA regulations (Part 450) enable our industry to adopt innovations that will catalyze growing contributions to the economy, environment, health, safety, and security of the United States. These Part 450 regulations include flexible, performance-based criteria in place of the formerly cumbersome, prescriptive requirements. ULA participated actively in the regulatory process and we are gratified that the company's comments, along with those of other thoughtful stakeholders, were well received by the FAA.

In order to maintain the integrity of the licensing process, we need effective enforcement. It may not be obvious, but the FAA has never denied an operational launch license. If the FAA has a problem or concern with a ULA license, they promptly flag the issue, and we make sure the issue is resolved well in advance of launch. These regulations exist for a reason; space launch is not as easy as we make it look. Industry is naturally going to trend towards pushing the boundaries, so it is vital that Congress provides FAA the support it needs to conduct effective oversight and enforcement of the licensing process. Responsible operators will comply with FAA regulations and licenses. Those who do not should face enforcement and impactful consequences.

INTEGRATING SPACEFLIGHT INTO THE NATIONAL AIRSPACE SYSTEM

The FAA has encouraged commercial space transportation and air transportation to work together in the interest of a safe and efficient National Airspace System (NAS). Despite grappling with the challenges posed by NAS' multiple uses, the progress already made is noteworthy.

With this kind of record at the FAA, it is incumbent upon the commercial space transportation industry not only to comply fully with regulations, orders, and guidance, but also to cooperate actively with the FAA and to accord its talented, dedicated, and hardworking women and men the respect and appreciation they so greatly deserve.

As we look forward to the not-so-distant future, the FAA's rising challenges are inevitable. Commercial launches and reentries will continue to increase in frequency and complexity, and numerous spaceports will be added, which will occupy an ever-widening expanse of the NAS. The emergence of commercial human spaceflight will entail new risks and opportunities, requiring the FAA's close attention. Likewise, the FAA will have to weigh carefully the environmental factors on land and in air, sea, and space, which attend the growth of commercial space transportation.

PROTECTING EARTH ORBIT—A NATURAL RESOURCE

There has been much attention devoted, especially lately, to the sustainability of the orbital regime; and rightly so. The advent of vast constellations of satellites in Low Earth Orbit has brought new opportunities to daily life here on earth, but has raised concerns about the increased risks of collisions and consequent debris. This could threaten the safety of astronauts and space objects. Moreover, it could further complicate the transit of launch vehicles and payloads, the safe disposal of rocket stages, and even render the affected orbits unusable for decades. The physical density of certain mega-constellations, along with autonomous, unpredictable, and undisclosed repositioning of spacecraft, could make certain orbital altitudes too crowded for use by other spacecraft and limit the practical launch access to fly through these shells to adjacent orbits.

On the other side of the equation, the benefits of satellite constellations are evident, and there are promising technologies for on-orbit satellite servicing and active

removal of dead spacecraft and other orbital debris. However, those capabilities may not be sufficient to adequately address the impending problems, at least not for the foreseeable future. As a launch provider, we have a vested interest in protecting the orbital regime so we can continue launching responsible customers to space. One way ULA remains proactive on this front is by safely disposing of our second stage rockets by placing them in a graveyard orbit or conducting a controlled reentry where most of the stage disintegrates over the remote, deep ocean.

In accordance with its statutory mandate, the FCC has strongly promoted the deployment of mega-constellations, with a focus on their benefits. The attention of other government organizations to the potentially negative impacts of mega-constellations is a welcome development, and I hope and expect that the FAA will lend its expertise. I would argue the FAA has a statutory role in this matter due to its charge to protect national security and national airspace users from reentering debris. We can't put national security satellites into orbit if we can't get there in one piece.

Foreign governments and multilateral organizations also have important roles to play. The United States does not have a monopoly on satellite constellations, and accordingly, the existing international rules of conduct for space activities must be revisited and new ones considered for this burgeoning area. I note that China plans to deploy 13,000 satellites in LEO and is providing robust funding and other government support to bring that about. Considering these circumstances, it is profoundly in the interest of the U.S. government to lead the way in confronting these issues with the invaluable work of the FAA.

ENABLING REGULATORY SUCCESS

When addressing the roles and responsibilities of the FAA, its relationship with commercial space transportation stakeholders, and the performance of its missions, it is important to recognize the outstanding contributions of the Commercial Space Transportation Advisory Committee—COMSTAC. ULA is represented on the Committee, so I take a special interest in its accomplishments and ongoing projects, from which the FAA, industry, and the public all benefit.

But, most important of all to the success of the FAA in regulating and promoting U.S. commercial space transportation is the foundational role of Congress. U.S. commercialization of space transportation has been possible only because Congress has remained committed to ensuring that our nation enjoys the countless, vitally important benefits enabled by this fast-growing industry, while maintaining safety as the highest priority and protecting our national security and foreign policy. The increased demand for licensing of launch, reentry, and spaceports must be matched by augmented administrative resources if commercial space transportation is to continue its rapid advance in the national interest. Accordingly, I, like others in the industry, strongly support the Fiscal Year 2022 budget request for increased funding for FAA/AST.

In closing, I wish to express my appreciation for your focus on the FAA and U.S. commercial space transportation. Your dedicated attention to this vitally important matter is indispensable to ensuring the continued support of Congress for the FAA and our industry. Again, thank you for inviting me to testify today. I look forward to answering your questions.

Mr. LARSEN. Thank you very much.

Now, the Chair will recognize Mr. Frank DiBello, president and CEO of Space Florida. You are recognized for 5 minutes.

Mr. DiBELLO. Chairman Larsen, Chairman DeFazio, Ranking Member Graves, and distinguished members of the subcommittee, thank you for this invitation. I am honored to share a Florida perspective on a topic of great importance to our State and to the Nation's leadership in space transportation.

Space Florida is a public corporation and independent special district established to strengthen Florida's leadership in aerospace research, investment, exploration, and commerce. We actively support development of space transportation assets at the Cape Canaveral Spaceport and at other designated spaceport territories in the State.

Florida hosts 4 of the 12 licensed commercial spaceports, and since 1989, has hosted over half of all FAA-licensed launches. Of the 31 licensed launches so far this year, nearly 60 percent were launched from privately developed or operated facilities at the Cape Canaveral Spaceport, which includes the Kennedy Space Center and Cape Canaveral Space Force Station.

Since January, launches from the Cape have demonstrated a cargo-lifting capability of over 400 metric tons to orbit. Further, 50 or more launches a year from Florida will soon become the norm, and future projections far exceed that number.

Years ago, Florida recognized its future and designated space transportation a distinct element of its strategic intermodal system. Space transportation is critical to our economy. Yet we recognize it is still an emerging industry and requires care in allowing new systems entering the market to operate within a flexible regulatory framework. The FAA must continue to develop and maintain this framework to support U.S. industry growth in the face of global competition.

With Florida's launch activity and busy air traffic corridors along our coast, we urge continued and increased FAA effort in technology and airspace management development to advance safe and efficient integration of space transportation with commercial aviation.

Florida is already providing an operational environment where industry and FAA can develop and mature improvements to future systems and procedures.

It is also worth noting that thanks in major part to more than \$1.5 billion in commercial spaceport investment by Florida and its industry partners, we now have a landscape of new and redeveloped launch and landing capability on sites once used solely for Government systems.

States have a clear role to play in the evolution of U.S. space transportation capability. National Space Transportation Policy directs Federal agencies to provide access to launch ranges, purchase U.S. space transportation services, and refrain from activities that preclude, discourage, or compete with U.S. commercial space providers.

These policies foster renewal and growth in America's space launch capability, but vital supporting ground infrastructure has not kept up at the same pace and is essential for future spaceport operations.

The U.S. Department of Transportation should embrace space transportation as yet another modal element that is critical to the economic and security well-being of the Nation, and ensure that these categories of supporting ground infrastructure are included in the Nation's infrastructure investment planning.

We urge Congress to authorize and fund a program aimed at enabling America's space transportation leadership. Such a program should be funded on a recurring basis and provide assistance to sites with demonstrated need by operational activity or market demand to advance objectives of national strategy.

In 2018, the FAA chartered an Aviation Rulemaking Committee to provide input on streamlined regulations for commercial space transportation. Space Florida was honored to participate. While our

industry continues to evaluate how the revised regulations will affect operations, there still remains much to be done.

We recognize that the FAA must adapt and grow its workforce to meet evolutionary regulatory changes. I want to commend the progress made by Associate Administrator Monteith in reorganizing and staffing to respond to these rapidly growing industry needs.

In this context, we believe FAA should focus on protection of the uninvolved public, people, and property, outside the controlled boundaries of a Federal, State, or private launch site. Launch site operators could assume greater responsibility for regulating activities of spaceport personnel both directly and not directly participating in the licensed activity, allowing greater FAA attention to the public outside the spaceport fence line.

Continued U.S. leadership depends on a regulatory structure that achieves public safety, while remaining flexible, to enable new technologies and operational approaches that advance U.S. capabilities.

I urge this committee to ensure that FAA engages in this unique industry in future rulemaking early and often, so that companies most knowledgeable about risks and the technologies involved can help inform development of FAA rules that both regulators and operators will live and succeed by.

Thank you again for the opportunity. I look forward to your questions.

[Mr. DiBello's prepared statement follows:]

Prepared Statement of Frank DiBello, President and Chief Executive Officer, Space Florida

Chairman Larsen, Ranking Member Graves, and distinguished members of the subcommittee, thank you for the invitation to testify before you today. I am honored to appear alongside my esteemed industry colleagues, to share with you a Florida perspective on this topic of crucial importance to our nation's leadership in space transportation. I applaud your leadership and willingness to examine a broad range of issues regarding the role of the FAA in regulating and enabling space transportation, and the importance of smart investments by all in growing the U.S. space transportation infrastructure to compete successfully in this global enterprise—an enterprise exceeding \$400 Billion in annual revenues.¹

BACKGROUND

Space Florida is a public corporation and Independent Special District of the State of Florida, established by an act of the Florida Legislature in 2006 to strengthen Florida's position as a global leader in aerospace research, investment, exploration, and commerce². To that end, it is the intent of the Legislature that Space Florida serve as the single point of contact for state aerospace-related activities with federal and state agencies, the military, and the private sector.

As Florida's aerospace industry development organization, we are committed to attracting and expanding the next generation of space industry businesses. Our team fosters the growth of a sustainable and world-leading aerospace industry in Florida, and supports the development of the Cape Canaveral Spaceport and other spaceport territories around the state. We accomplish this mission by implementing strategies and utilizing financial and other development tools designed to foster the growth of Florida's aerospace industry:

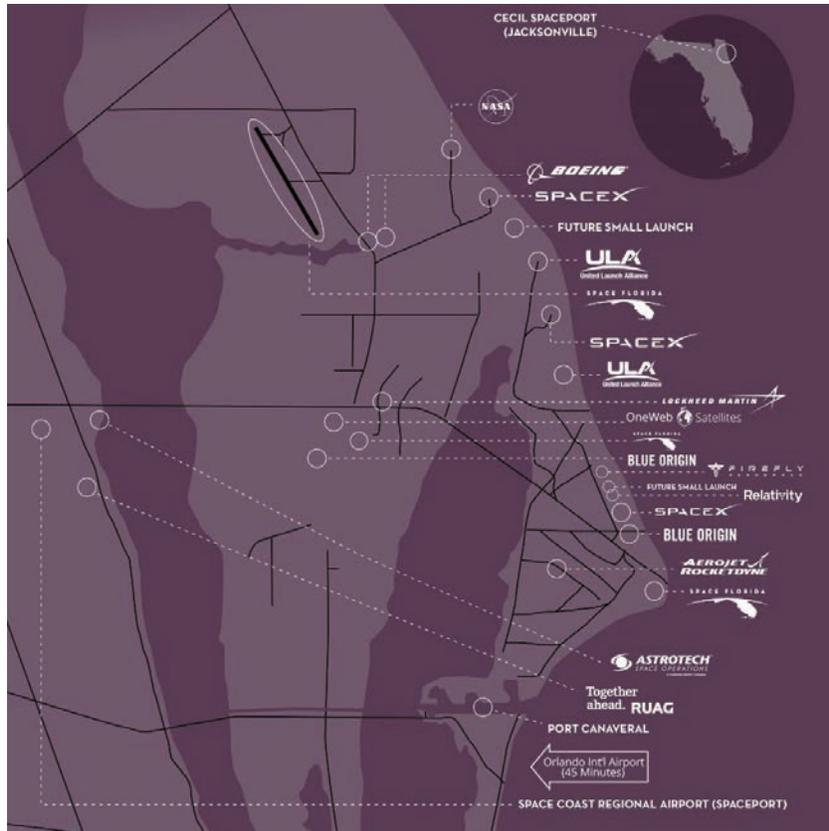
- Developing a master plan for growth and development of the Cape Canaveral Spaceport, and a statewide spaceports systems plan to guide development of a

¹The Space Report 2020: The Authoritative Guide to Global Space Activity, Space Foundation

²Chapter 331, Part II Florida Statutes

network of commercial spaceports and the supporting freight, logistics and supply chain infrastructure around Florida

- Partnering with NASA and the U.S. Space Force to make underutilized federal assets or assets no longer needed for mission purposes at Kennedy Space Center and Cape Canaveral Space Force Station available to commercial customers of the Cape Canaveral Spaceport
- Supporting infrastructure development to enable growth of commercial space companies at the Florida spaceports, aided by Florida Department of Transportation's Spaceport Improvement Program infrastructure funding
- Providing appropriate financing structures to enable growth of aerospace companies around Florida by constructing new facilities and acquiring machinery and equipment
- Increasing capital sources available to growing Florida aerospace companies through capital acceleration events conducted with the Florida Venture Forum and other financial institutions



Map of Cape Canaveral Spaceport tenants, with Space Coast Regional Spaceport and Cecil Spaceport inset

FLORIDA'S PLACE IN 21ST CENTURY COMMERCIAL SPACE TRANSPORTATION AND THE FAA'S ROLE

Florida was where the nation entered the global commercial market for space transportation, beginning with the Government's launching of the earliest commercial telecommunications satellites. In 1998, Spaceport Florida's Cape Canaveral

Spaceport launch site was used for the first launch from an FAA-licensed, state-operated site.³

Today, Florida hosts four of the FAA's 12 licensed commercial spaceports⁴ and a corresponding majority of the launch licensing demand on the FAA. Of the licensed U.S. launches thus far this year, nearly 60% lifted off from privately developed and operated facilities at the Cape Canaveral Spaceport⁵, the state's statutory designation of the territory comprised of the Cape Canaveral Space Force Station and the Kennedy Space Center⁶. Since the beginning of the FAA launch licensing program in 1989, Florida has accounted for more than half of this launch activity⁷. Landings are also becoming commonplace, adding to the activity at the spaceport.

It should be apparent then why Florida designated space transportation as a distinct modal element of its statewide Strategic Intermodal System, almost two decades ago. Space transportation is critical to our state and our country's inter-connected networks of air, maritime, and surface transportation. Just over the past six months, launches from the Cape have demonstrated a capability of lifting nearly 400 metric tons⁸ of cargo into space. This may not seem like a lot of freight to the experts who are familiar with the metrics of U.S. seaport shipping, domestic air freight movement, or the volume of cargo hauled across our National Highway System. But this concentration of space launch capacity, all enabled by a growing fleet of commercially owned and operated U.S. launch providers, is unmatched anywhere else on the planet. It offers America a significant advantage as the international competition for economic and military dominance in space accelerates.

The launch cadence has increased dramatically over the last few years, with 20 launches in the last six months and 24 additional launches projected by the end of the year. 50+ launches a year for Florida will become the norm, with future projections far exceeding that number⁹. Yet, this is still an emerging industry, and requires care in allowing new systems entering the market to operate with a flexible regulatory framework. Accordingly, the FAA's challenge in effectively applying this framework and meeting an increasing cadence is placing new demands on its human and technical resources. Further, despite the efforts of the FAA and the other installation owners at the U.S. Eastern Range, not all overlapping and duplicative rule sets have been eliminated. While these streamlining efforts are continuing, as long as duplication and overlap continues, there will be an unnecessary burden on all parties, burden that does nothing to enhance public safety.

With Florida's increasing share of FAA licensing activity, coupled with the heavily-used domestic and international air traffic corridors along our coast, Space Florida urges an increased FAA effort in technology development and deployment to advance the safe and efficient integration of routine space transportation with commercial aviation. Florida is already providing an operational environment where industry working with FAA can identify and mature improvements to existing systems and procedures. We are eager to support further FAA focus in this area.

COMMERCIAL SPACE TRANSPORTATION INFRASTRUCTURE: ROLE OF USDOT AND THE FAA

The final Space Shuttle launch took place 10 years ago this July. In the past decade, there have been more launches of commercially owned and operated launch vehicles than there were Space Shuttle launches during that 30-year program. This commercial success has been enabled by more than \$1.5 Billion in commercial spaceport investment by Florida and its industry partners¹⁰. This investment has produced a landscape of new and redeveloped launch complexes on sites once used for Government systems. It has also brought new manufacturing and support facilities operated by or for the commercial providers and customers.

Cape Canaveral Spaceport has emerged as the world's busiest commercial spaceport. This success validates the wisdom of a national space policy that promotes the

³ FAA Office of Commercial Space Transportation database of licensed launches; 2017 Cape Canaveral Spaceport Master Plan

⁴ FAA Office of Spaceports

⁵ FAA Office of Commercial Space Transportation database of licensed launches

⁶ Chapter 331, Sec. 304 (1), Part II Florida Statutes

⁷ FAA Office of Commercial Space Transportation database of licensed launches

⁸ 45th Space Launch Delta manifest; commercial launch provider vehicle payload capacity

⁹ 45th Space Launch Delta launch data and forecast

¹⁰ Florida Department of Transportation/Space Florida rollup of 34 major projects funded with over \$312 million from Florida's Spaceport Improvement Program combined with over \$1.26 billion in private contribution from industry participants in the program since July 2011 (FY 2012). Does not include more than \$450 million in Space Florida-facilitated private financing for commercial spaceport investments prior to the end of 2012.

participation of state governments to facilitate private sector investment and operation of space transportation infrastructure. States are powerful tools, with unique capabilities not found in federal agencies. To meet the challenge of assuring US leadership in the commercial marketplace, in exploration, and in national security space, this nation must bring all of its capacity to the contest. The metrics of commercial launch activity in Florida highlight the space mission outcomes of that policy: more than two dozen missions to the International Space Station, including the return of U.S. human spaceflight from American soil; hundreds of satellites serving global user markets for telecommunications, navigation, and other services; and new capabilities and services in support of NASA, U.S. Space Force, and international demand for space access.

The 2013 National Space Transportation Policy, which remains in place, directs federal agencies to facilitate access to the launch property on its ranges, purchase and use U.S. commercial space transportation capabilities and services, and refrain from activities that preclude, discourage, or compete with U.S. commercial space transportation activities¹¹.

While these policies have been very successful in renewing America's space launch capacity with commercial capabilities, the common use infrastructure that is vital to connecting these capabilities to the required support infrastructure has not kept up at the Cape and other locations around the country. Much of the property is still owned and operated in large measure by the Government, or by other public entities. The US Government should consider enabling the private partnership redevelopment of infrastructure at individual sites it no longer needs, upkeep of aging road and utility networks, and development of increased commodities and services needed for these commercial providers.

It is time for a strategic and effective infrastructure policy and program to grow the nation's commercial space transportation system. The U.S. Department of Transportation and the FAA should embrace space transportation as another modal element critical to the well-being of the nation's economy by including space transportation in the nation's infrastructure investments.

Space Florida was a successful applicant for a USDOT \$90 million Infrastructure for Rebuilding America (INFRA) Grant to enable the replacement of NASA's failing 1964 bridge over the Indian River¹², a primary surface transportation route used to transport both freight and people to the entire Cape Canaveral Spaceport. Florida's Department of Transportation and Space Florida are providing the non-federal match for this new asset as well as a connector highway to Space Florida's space commerce park located on NASA property.

We join with many of our colleagues in the commercial space transportation industry—licensed commercial spaceports and operators, including those using their own private sites—in calling on the Congress to authorize and fund an infrastructure program aimed at enabling America's space transportation leadership. We believe such a program should be adequately funded on a recurring annual basis, prioritize grant funding for sites where there is a demonstrated need by operational activity or clear market demand, and advance the objectives of a national strategy. Florida has employed such approaches in its own Spaceport Improvement Program. We would be happy to lend our experience and discuss this further with the Committee if helpful.

In reviewing the GAO report on commercial space transportation infrastructure¹³, we agree with its findings that a broader consideration of approaches and funding sources other than those existing programs initially identified by the FAA is not only appropriate and timely, but necessary for the U.S. to sustain its leadership.

WHY FAA'S ROLE IN ASSURING PUBLIC SAFETY FOR PEOPLE AND PROPERTY MUST BE RETOOLED

Just as we concur with the GAO's findings regarding the FAA's need to find new approaches to enabling infrastructure, we also concur with its findings that the FAA must adapt and grow its workforce to meet the challenges of a dynamic and rapidly expanding space industry. I want to acknowledge the progress that has been made by Associate Administrator Monteith in reorganizing and staffing to respond to these challenges. It is no easy task he has. We know that the successful implementation of new performance-based rules, and the ongoing revolution in emerging

¹¹ National Space Transportation Policy, 2013. Accessed through the Department of Commerce

¹² INFRA Grant Award, announced July 25, 2019 by the US Department of Transportation

¹³ Commercial Space Transportation: FAA Should Examine a Range of Options to Support U.S. Launch Infrastructure, GAO report 21-154, released December 22, 2020

space technologies require the right people with the right skills doing the right jobs in the most efficient and effective manner possible.

The Federal Aviation Administration chartered the Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee (ARC) in 2018 to provide a forum to discuss current and potential future regulations setting forth procedures and requirements for commercial space transportation launch and reentry licensing for the FAA's consideration. The FAA tasked the ARC to develop recommendations for a performance-based regulatory approach in which the regulations state safety objectives to be achieved, and leave design or operational solutions up to the applicant. Space Florida was honored to participate in this activity. Along with the rest of our industry, we are continuing to evaluate how the new Part 450 regulations will affect our ability to increase the operational density (geographic proximity) and intensity (frequency of operational activity) of space transportation operations at the Cape. We are keenly aware that the FAA's elaboration on how spaceports and operators may meet the new regulations through acceptable means of compliance will depend on the content of many Advisory Circulars which still need to be produced.

We continue to believe, as do many of the commercial operators we served on the ARC with, that the FAA should focus its public safety efforts on protection of people and property outside the controlled boundaries of a federal, state, or private launch site and redefine its safety role when it comes to regulating the activities of personnel that are not directly participating in a licensed activity, such as neighboring operators, or others on a space launch facility. That would mean a greater role and responsibility for the site operators to mitigate hazard risks to their employees and vendors.

The competitiveness of the U.S. in the international rivalry for space dominance depends on ensuring a regulatory structure that achieves its focus on public safety, while retaining the flexibility to enable new technologies and operational approaches to advance U.S. space transportation capabilities. Rulemaking is a lengthy process with long-lasting consequences. It is imperative to hear from all involved stakeholders to ensure we can get it right. For all future rulemaking and associated regulatory processes, I urge this Committee to ensure that the FAA engages with this unique industry early and often, so that the companies most knowledgeable about the risks and technologies involved can do their best to help inform the development of the FAA rules that all, regulators as well as operators, will have to live by.

Chairman Larsen, Ranking Member Graves, and members of the subcommittee, thank you again for the opportunity to testify today. I look forward to your questions.

Mr. LARSEN. Thank you very much, Mr. DiBello.

I now turn to Captain Joe DePete, president of the Air Line Pilots Association, International.

Captain, you are recognized for 5 minutes.

Mr. DEPETE. Thank you, Chairman Larsen and Ranking Member Graves and members of the subcommittee. I am Captain Joe DePete, president of the Air Line Pilots Association, International, which represents more than 59,000 pilots who fly for 35 airlines.

Now, let me make clear that ALPA supports a safe integration of new and expanding users of the national airspace, including commercial spaceflight operations. As the world's largest non-governmental aviation safety organization, we are equally committed to ensuring that new entrants do not create new risks.

U.S. air transportation is the safest in the world, and this subcommittee's leadership is among the reasons why. Another reason is the highly unionized U.S. aviation workforce that has put safety first over the past century of flight.

As ALPA celebrates our 90th anniversary, we recognize our responsibility to share the lessons pilots have learned and make certain that the United States continues to put safety first in the national airspace, a critical component of U.S. transportation infrastructure.

The FAA forecasts an increase in U.S. launch activities by as much as 100 percent by 2025. In response, the FAA must build upon a pattern of collaboration by the aviation and aerospace sectors.

For years, ALPA has facilitated data sharing between the aviation and aerospace industries. For example, ALPA and the Commercial Spaceflight Federation held a 2019 symposium that culminated in a joint statement affirming that both sectors would work towards a common goal. ALPA believes, now more than ever, that the FAA, industry, and labor can work together to create a national space integration strategy.

In 2018, ALPA issued a white paper that called for such a strategy to include establishing a proactive, risk-predictive safety culture in spaceflight operations through safety management systems for manufacturing, operations, and spaceport licensing; creating commercial astronaut licensing and training standard that align with those of other professionals who operate in the national airspace; and developing orbital debris reentry standards for planned and unplanned reentries that could affect public safety.

To that end, I would like to state ALPA's support for the Aerospace Debris Safety Act. A national strategy will enable all airspace users to create a shared mental model for the future. In the meantime, the FAA can enhance collaboration, without additional funding or authorization, by creating an advisory structure that brings together commercial space, drone, and aviation operators, which all use the airspace but currently provide input separately.

By creating a national integration strategy, the FAA will also reduce emissions. We urge the FAA to renew and review launch and mission standards and consider lower emission fuels.

As the United States continues to segregate rather than integrate commercial space, we needlessly increase emissions during launches by forcing aircraft to fly around segregated airspace or wait until it reopens. Right now, airline pilots already face operational issues involving spaceflight, as recently demonstrated by uncontrolled space debris reentry events.

We believe the FAA must take actions, including establishing launch planning and recovery standards, creating standards to make certain that very large pieces of space debris reenter at a predefined location and time, and requiring notification of pilots, airlines, and controllers not directly involved in a space launch about the risk level changes in that airspace.

ALPA recognizes that uncontrolled space debris reentry is, of course, a global safety issue, and we recently sent a letter to the ICAO Secretary General, calling for international actions to be taken.

As we consider the promise but also the challenges of increased spaceflight, the aviation and aerospace sectors have a proven model to follow to ensure safety. Through the Commercial Aviation Safety Team, labor, airlines, manufacturers, industry, and the FAA have collaborated to address risk in aviation with remarkable success. A similar data-driven, risk-based construct will help create a proactive safety culture for commercial spaceflight as well.

Thank you for the subcommittee's recognition of the crucial role airline pilots play in maintaining the safety of air transportation

as we continue to drive the U.S. public health and economic recovery, keep supply chains open, and safely transport our passengers. Thank you very much for the opportunity today.
[Mr. DePete's prepared statement follows:]

Prepared Statement of Captain Joseph G. DePete, President, Air Line Pilots Association, International

On behalf of the Air Line Pilots Association, International (ALPA), I want to thank you, Chairman Larsen and Ranking Member Graves, for inviting me to testify on the very important role that the Federal Aviation Administration (FAA) has in the future of spaceflight. My name is Captain Joe DePete, and I serve as the president of ALPA. ALPA is the largest airline pilot union in the world, as well as the largest nongovernmental aviation safety organization in the world, with a history of safety advocacy spanning more than 90 years.

ALPA's focus on spaceflight operational integration has been ongoing for more than five years and our primary focus is on ensuring that no new risks to airline operations are introduced by space operations. Based on recent events, there is a lot of work that needs to be done very quickly by the FAA in cooperation with other parts of government to ensure that the skies occupied by airline traffic remain safe, as the frequency of commercial space operations continue to climb.

COLLABORATION WITH COMMERCIAL SPACE INDUSTRY

ALPA is a tremendous supporter of our Nation's commercial space industry. I am proud of the role that we have had in increasing collaboration that has occurred between the space and airline industry stakeholders. ALPA has worked particularly hard to reach across the aisle and engage in meaningful discussions with the commercial space industry members represented by the Commercial Spaceflight Federation (CSF). We have also worked to bring other aviation industry representatives into the discussion. Our interactions were brought onto a more public stage in October of 2019, when ALPA and the CSF jointly held a 1-day symposium called *Safe Skies for All: Introducing Spaceflight Into Our Skies*. The culmination of that day was a joint statement on the need to collaborate and work as two separate industries towards a common goal. We said:

ALPA and CSF vow to continue to work together to improve the commercial aviation and space community's understanding of each other's technologies, operations, and constraints; to explore potential solutions to conflicting demands for airspace; and to advocate for optimized use of airspace around launch and reentry activities. We agree that the status quo cannot continue and the private sector must help the FAA innovate to minimize any negative impacts of the growing commercial aviation and space industries. As leaders of our respective industries, ALPA and CSF have taken cooperative action to solve these problems. We're working with colleagues and other key stakeholders to improve how we operate today, as well as advocating for investments in new air traffic control tools that will better optimize airspace while preserving safety as we enjoy future growth in both air and space transportation.

It is with this continued spirit of collaboration that I sit here today and share with you, our thoughts on the FAA's role in the future of commercial spaceflight.

SPACE LAUNCH ACTIVITIES FORECAST TO RISE

During the 2020 global pandemic, the FAA continued to approve commercial space launches, most of which depart and fly over oceanic airspace. However, domestic sub-orbital launches are expected to commence in the near future and each launch will require the FAA to protect large swaths of airspace just in case a space operation fails to achieve its planned operation.

The rate of rocket launch activities is accelerating. Worldwide, the number of space launches increased by 54%, from 74 launches in 2010 to 114 launches in calendar year 2020¹. This trend is expected to continue through the 2020s, with the FAA Office of Commercial Space forecasting a further increase between 36% to

¹ <https://www.spacelaunchreport.com/logyear.html>

100% in the U.S. alone by the fiscal year 2025. Industry estimates are even higher with a fiscal year 2025 growth of 177% over 2020².

I would like to discuss three areas with you today. From an airline pilot perspective, they are the three most pressing safety issues that need to be addressed by the FAA. I believe that it is very important that the FAA take both strategic and tactical leadership actions on these critical safety concerns.

A SYSTEMATIC SPACE INTEGRATION STRATEGY IS [STILL] NEEDED

In our 2018 white paper, *Addressing the Challenges to Aviation from Evolving Space Transportation*, we highlighted the numerous challenges that the tremendous growth in commercial space operations will present to the nation, including space operator approval, spaceport licensing, regulations for spacecraft crew and participants, spacecraft design standards, and other critical areas. It is ALPA's belief that the number of commercial space launches and recoveries will rapidly escalate in the next ten years, and that the U.S. will lead by example in successful commercial space operations that are safely-integrated with the commercial aviation industry. Our carefully chosen words at that time still ring true today:

The FAA needs a comprehensive plan to integrate commercial space operations and avoid major disruptions for the other users of the NAS as the demand for access to the NAS for commercial space operations increases. As commercial space operations increase, and as the commercial space operations locations continue to expand ... [there is a need] to reduce NAS impacts while maintaining a high level of safety. At some point, segregation of commercial aviation operations from commercial space operations will not be a viable solution.

In the years that have passed since ALPA penned those words, we have seen some progress in the most publicly visible "pain point" for the traveling public: launch induced delays. We have seen the space industry and the FAA work to create systems and procedures to better disseminate information for air traffic controllers and airline operations centers, and we have seen a high degree of launch vehicle performance and reliability as American astronauts have resumed their travel on American rockets. All of these positive steps are evidence of continuous improvements of spaceflight *accommodation*. However, ALPA has not seen any of the much needed steps by the FAA, to start the *integration* process. We believe that now more than ever, a comprehensive strategy is needed, so that we do not lose sight of the ultimate goal. Areas that must be addressed in this strategy, include:

- A comprehensive system safety performance framework including both hardware and software standards designed for normal and non-normal operations.
- Safety Management System for manufacturing, operations, and spaceport licensing.
- A comprehensive plan for airspace management coordination tools and capabilities
- Orbital debris reentry standards as well as a comprehensive plan for when orbital debris may impact aviation operations.
- Astronaut licensing, training and recurrency standards associated with the operation in the National Airspace System

We are concerned that without a strategy, safety risks may either be under-rated or unidentified altogether. However, it is important to note that we are not asking the FAA to regulate the Commercial Space industry as if they are starting from square one or to dramatically impose severe constraints. The industry is very successful at what they do, and each successful rocket launch proves this point. Instead, we are encouraging all stakeholders to jointly develop and define a goal for the future and then ensure that each decision point made along the way is consistent with that envisioned operational future. If we do not have a common goal in mind, and if it is not a shared goal, then we cannot create a shared mental model of the various strategies that we can collectively and individually use to reach the envisioned level of safety with full operational integration.

CREATING A SHARED MENTAL MODEL ON INTEGRATION

There is another aspect of strategic thinking that I know the FAA can immediately implement, without any funding or authorization: Establish an overarching integration advisory structure. I realize that we are discussing the topic of space op-

² https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Commercial_Space.pdf

erations today. However, I believe that the FAA needs to hear from the breadth of our Nation's airspace operators from a single vantage point on integration of all types of aircraft and spacecraft. I also believe that the aviation and space segments need to create a "shared mental model" where there is broad agreement on how the airspace will be used in the future. But we cannot create a shared mental model if we do not get all of the players together, along with the FAA, at the same table.

It strikes me as odd that the FAA's various operational advisory committees do not interact with each other. They are by definition, segregated. This segregation into narrow focus areas includes commercial space, drones and aviation. Each industry segment has their respective advisory committee including the Commercial Space Transportation Advisory Committee (COMSTAC), the Drone Advisory Committee (DAC), and the NextGen Advisory Committee (NAC). However these segregated committees never interact, or step back to see how their needs affect other airspace operators. We need de-segregation of the airspace user community.

If the FAA were to establish a broader integration committee, it would also mean that they should cross-pollinate the commercial space industry into mainstream aviation industry advisory committees. I will forever remember my first visit to the Commercial Space Transportation Advisory Committee (COMSTAC) meeting in the gallery as a member of the public. At that meeting I took the opportunity to share my belief that we are stronger working together than we are working independently. I shared my passion for a proactive safety risk mitigation philosophy instead of the reactive or forensic based safety advancement model. I was able to share the facts about how much safer the airline industry has become with proactive, data-driven safety risk analysis. I was very excited when multiple COMSTAC members engaged in a discussion that was neither scheduled nor scripted. We took the time to collaborate and began developing a common understanding of each industries airspace needs and safety requirements. That left a very distinct feeling of hope and optimism that someday we will all be working together to achieve incredible results that are mutually beneficial to all Americans now matter what their airspace needs would be.

In my time serving as ALPA president and before that, as First Vice President and National Safety Coordinator I have had the privilege of serving on numerous Federal Advisory Committees and I fully support an integrated group of stakeholders who jointly need to be tasked by the FAA to provide valuable feedback on important safety and operational topics relevant to all airspace users. It's our recommendation that the FAA:

- Identify a means by which to obtain an integrated set of industry recommendations on how to successfully achieve future operations.
- Review the structure of the current committees and find a way to develop recommendations with an underlying assumption that the FAA will continue to oversee the operations of all aircraft and spacecraft in the National Airspace System (NAS), which will continue to be a national resource to be shared by all.
- Seek input on a consensus based strategic plan with a target date for commercial space integration that allows the Commercial Space operators to "file and fly" without segregation / sterilization of airspace areas.

I believe that these strategic steps are the right steps for the FAA to take in support of the future of our country and our country's airspace system.

FOCUS ON ENVIRONMENTAL IMPACT

It should not need to be said, that there is critical work to be done immediately to limit the environmental impact from commercial space operations. While the focus on environmental impact may not have been considered a significant concern in the past when space operations were less frequent, the increased frequency of the launches today dictates a necessity to address the environmental impacts associated with commercial space launches. Many rocket launches utilize fossil fuels, and the carbon emissions from a rocket launch are easily measurable. They can be reduced through an increased focus on environmental impacts. With rocket launches combined with the added fuel burn required by aircraft due to flight diversions around airspace designated for rocket launches, the total impact of space operations should be recognized and address as part of the FAA's focus going forward. Developing alternative fuel strategies in addition to developing and implementing the Commercial Space integration strategy as quickly as possible is critical. We must not allow any airspace user to be given a "hall pass" on this important topic.

NEAR-TERM CONCERNS

In addition to the strategic activities that we believe the FAA should be fostering, I would also like to take a few minutes and highlight real-world examples of operational issues that airline pilots must contend with today, that have not been an issue until relatively recently.

UNCONTROLLED ROCKET RE-ENTRY EVENTS

Two recent uncontrolled and unscheduled space debris re-entry events have exposed a troubling trend. The events include a March 25, 2021 Space-X Falcon 9 second stage re-entry over the Northwestern United States and Southwestern Canada, and a Long March CZ-5B-Y1 rocket on May 9, 2021, in the Indian Ocean. In the span of just 45 days, many tons of rocket components have re-entered the atmosphere as out-of-control space debris, putting many lives at risk. This includes those lives that were in-flight on airline aircraft and were likely unaware of the potential danger that they might encounter. Only after the re-entry had occurred, did the real safety threat become much more obvious.

In the case of the Space-X re-entry, we know that the second stage did not have sufficient propellant left to have a controlled de-orbit, and therefore Space-X lost control of the booster, which was left orbiting the earth for weeks (not hours or days) before its re-entry. There was ample time to evaluate and plan for any potential risks resulting from the unplanned re-entry. Despite the second stage design to minimize debris, several components did survive re-entry and impacted the ground.

In the days following the March 25 re-entry, several pieces of the Space-X second stage were recovered, and some of them reportedly weighed upwards of 300 pounds (136.7 kg). We are unaware of any warnings or cautions issued by Space X, or either of the Air Navigation Service Providers (ANSPs) in the U.S. or Canada, once it was known that the re-entry could occur in continental U.S. and Canadian airspace. We are also unaware of any warnings issued by public safety agencies to generally alert the global aviation community in advance of the event.

The second re-entry event involved a Long March CZ-5B-Y1 rocket, which was among the 10 largest pieces of human-made space debris to ever re-enter the earth's atmosphere. The rocket booster re-entered over the Indian Ocean approximately 50 minutes earlier than the final prediction provided by The Aerospace Corporation. If it had re-entered 15 minutes later than predicted, it would have occurred over central Florida. If re-entry had occurred 105 minutes later than predicted, it would have been over Washington, DC, and much of the continental U.S. in the moments before that.

In May 2020, a similar Long March CZ-5B-Y1 rocket also re-entered the atmosphere and like the Space-X Falcon 9, some of the booster components fell all the way to the ground, within the Republic of Côte d'Ivoire. Publicly available news reports indicate that another CZ-5B-Y1 booster will be used in the near future, and a re-entry event like the May 9 event will occur again.

Publicly, news agencies and experts report that this rocket booster is not equipped with the capability to ensure that its re-entry can be controlled, or even accurately predicted.

The airline industry long ago realized that the "big sky theory" was not an acceptable collision risk mitigation strategy, and yet there seems to be an ongoing view that the "big sky theory" is an acceptable risk for space debris re-entry. The problem becomes even more apparent when looking at the forecast for increased future launches.

Thus, the two uncontrolled re-entry events and the risk they pose to aviation are noteworthy, given the strong safety record the airline industry in the U.S. has worked so hard to achieve. Although neither event created an aviation or ground-related casualty, several issues have been identified by ALPA that we believe are a global threat to aviation safety and need to be addressed by the FAA.

- The need for standards for launch planning and recovery, as well as risk mitigation, should unplanned events occur during the launch and recovery.
- The need for standards for space debris that at a minimum, includes "design for demise" requirements, as well as vehicle design requirements to ensure that very large pieces of space debris are controllable enough to ensure that the re-entry occurs at a pre-defined location and time.
- The FAA and their government agency partners need to greatly increase information dissemination before and during re-entry events, so that aviation operations have adequate advance notice, as well as ongoing updates on the re-entry data as it becomes available. Even if there are "design to demise" plans in place, the risk of an unanticipated space debris reentry needs to be communicated. If necessary, the FAA air traffic control should direct pilots away from

possible areas at risk to collisions from components that are falling through the airspace, during the re-entry.

It is important to recognize that this is not just an issue that we must face as a Nation, it is a global issue. Therefore, last month I sent an urgent letter of request to the ICAO Secretary General with many of these same facts and concerns, and I asked the Secretary General to begin work immediately to address the global risks to passengers and flight crews from space debris reentry. I continue to anxiously wait for a response. A copy of the letter is included at the end of my statement.

ELEVATED LEVELS OF RISK IN THE VICINITY OF SPACE OPERATIONS

As discussed earlier, prior to each rocket launch, the FAA air traffic controllers work to clear the airspace in the vicinity of the launch pad and under the rocket's planned flight path to orbit. The airspace is also sterilized for any of the boosters that return to earth, as part of the rocket operation. The size and duration of the airspace is relative to the size and complexity of each rocket launch operation.

The FAA has recently implemented an airspace risk mitigation procedure called Acceptable Level of Risk (ALR)³. In the simplest of terms, ALR reduces the volume of airspace that is segregated based on the results of mathematical risk analysis, which shows that risks of exposure to a rocket mishap is acceptable based on the time an aircraft will operate in areas of higher risk and potentially be exposed to rocket debris. While this is not a secret policy change, the FAA does not sufficiently notify pilots, airlines, or controllers not directly involved in a space launch of these changes in risk levels of airspace near the rocket launches, rocket reentry, launch trajectory zones, or of off-nominal events. Additionally, the FAA does not provide pilots or dispatchers with maps, coordinates or other details about the ALR airspace zones in which there is a reduced level of safety.

ALPA has raised questions and have expressed concerns on numerous occasions, about the lack of information disseminated to line pilots about ALR operations, and the increased level of risk that pilots are being asked to accept, most of the time unbeknown to them. ALPA believes operators of the NAS (pilots and controllers) need to be provided with ALR related information prior to every flight that will be exposed to ALR operations, and we believe that the FAA needs to publish clear guidance on the ALR operations so that pilots can make an informed decision about their flight's exposure to the ALR airspace area. ALPA recommends that the FAA:

- Develop and distribute educational materials, as well as update the Aeronautical Information Manual (AIM) explaining the ALR concept, the risks that the FAA has identified when operating in the ALR airspace and describe the type of air traffic control services available to pilots should the need arise. The FAA should also include instructions on how pilots can elect to avoid the ALR airspace if they prefer.
- For each rocket launch that utilizes ALR airspace risk mitigation procedures, publish Notices to Airmen with graphical depictions and information that can be displayed on a map, of the ALR airspace area that includes relevant navigation airways and waypoints, so that pilots, dispatchers, and airlines can evaluate the risks to their flight, by understanding the size, location and duration of the time they are operating in ALR airspace.
- Ensure that air traffic controllers have adequate tools and capabilities to provide flight crews with air traffic services for all operations in the vicinity of rocket launches, reentries, and during off-nominal events.

I often refer to ALPA members as "front line workers." Whether they are working day-in and day-out during a global pandemic and the risks to their health during their work day, or whether they are flying in ALR airspace or in a portion of the sky where there is the potential for rocket debris re-entering the atmosphere above them, airline pilots are continuously focused on ensuring that their passengers, cabin crew members, and cargo reach their destination safely. However, ALPA pilots are not alone in this effort to achieve the highest levels of safety. Instead, airline pilots rely on air traffic controllers, dispatchers and our fellow crew members in the cabin to help us safely complete each and every flight. The need for information dissemination across all of these worker groups is critical, and until we have a solid framework in place to ensure every user of the airspace is aware of the risks of a space debris reentry, and understands ALR operations and their expected roles, we believe that the FAA has important steps to take immediately. We should not be

³For a description of the FAA ALR see the document at the following web link: https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/risk_management/media/2018-04-27-FAASRMGuidance-ALR_signed_508.pdf

allowing any airspace operator to be unaware of either of these very important safety issues.

CONCLUSION

The level of safety that the traveling public has come to expect cannot be maintained in the future world where rocket launches are expected to be a frequent occurrence across our great nation, without a strategy to get us there. It's a very important step to take. But while we work on that strategy, we urgently need to work on the exchange and dissemination of what I would consider to be mission-critical operational information. The uncontrollable re-entry of a large piece of space debris into the atmosphere over domestic airspace, and the ALR airspace concept are two very appropriate examples of the type of information that would be very beneficial to pilots who are striving to complete their safety mission.

ALPA stands by as a committed, willing partner as we continue to chart a path on these very important topics into the future. We appreciate your recognition of the unique and critical role played by pilots and all airline workers to safely maintain our air transportation system, support our national economy, and position both the aviation and the space industry for seamless operations in the future. Along with these suggestions, please accept our offer to provide the necessary personnel from ALPA to assist the FAA in these activities. I firmly believe that the FAA is well-positioned to immediately address the issues. I stand firm in the belief that through collaboration and a common goal to achieve the highest possible safety levels, that the space community and the aviation community can rise above the challenges we are currently facing to the benefit of all humanity. Thank you for your continued oversight of this very important topic.

ATTACHMENT

MAY 14, 2021.

Dr. FANG LIU,
Secretary General,
International Civil Aviation Organization (ICAO), 999 Robert-Bourassa Boulevard,
Montréal, Québec H3C 5H7 Canada.

DEAR SECRETARY-GENERAL LIU:

The Air Line Pilots Association, International (ALPA), representing the safety interests of over 59,000 professional airline pilots flying for 35 airlines in the United States (U.S.) and Canada, has closely monitored the rapid increase in global space operations. Our focus on space flight operational integration has been ongoing for more than five years and our concerns are primarily focused on ensuring that no new risks to airline operations are introduced by space operations. Based on recent events, we believe that there is a lot of work that needs to be done very quickly and I ask that International Civil Aviation Organization (ICAO) take leadership on this critical safety concern.

Two recent uncontrolled and unscheduled space debris re-entry events have exposed a major risk. The events include a March 25, 2021 Space-X Falcon 9 second stage re-entry over the Northwestern United States and Southwestern Canada, and a CZ-5B-Y1 rocket on May 9, 2021, in the Indian Ocean. In the span of just 45 days, many tons of rocket components have re-entered the atmosphere as out-of-control space debris, putting many lives at risk. This includes those lives that were in-flight on airline aircraft and were likely unaware of the potential danger that they might encounter. Only after the re-entry had occurred, did the real safety threat become much more obvious.

In the case of the Space-X re-entry, we know that the second stage encountered a mechanical difficulty and was adrift, orbiting the earth for weeks before its re-entry. There was ample time to evaluate and plan for any potential risks resulting from the unplanned re-entry. Despite the second stage design to minimize debris, several components of the Falcon 9 did survive re-entry and impacted the ground.

In the days following the March 25 re-entry, several pieces of the Space-X second stage were recovered, and some of them reportedly weighed upwards of 300 pounds (136.7 kg). We are unaware of any warnings or cautions issued by Space X, or either of the Air Navigation Service Providers (ANSPs) in the U.S. or Canada, once it was known that the re-entry would occur in continental U.S. and Canadian airspace. We are also unaware of any warnings issued by public safety agencies to generally alert the global aviation community in advance of the event.

The second re-entry event involved a CZ-5B-Y1 rocket, which was among the 10 largest pieces of human-made space debris to re-enter the earth's atmosphere. The rocket booster re-entered over the Indian Ocean approximately 50 minutes earlier

than the final prediction provided by The Aerospace Corporation. If it had re-entered 15 minutes later than predicted, it would have occurred over central Florida. If re-entry had occurred 105 minutes later than predicted, it would have been over Washington, DC, and much of the continental U.S. in the moments before that.

In May 2020, a CZ-58-Y1 rocket also re-entered the atmosphere and like the Space-X Falcon 9, some of the booster components fell all the way to the ground, within the Republic of Côte d'Ivoire. Publicly available news reports indicate that another CZ-5B-Y1 booster will be used in the near future, and a re-entry event like the May 9 event will occur again. Publicly, news agencies and experts report that this rocket booster is not equipped with the capability to ensure that its re-entry can be controlled, or even accurately predicted.

The airline industry long ago realized that the “big sky theory” was not an acceptable collision risk mitigation strategy, and yet there seems to be an ongoing view that the “big sky theory” is an acceptable level of risk for space debris re-entry. The problem becomes even more apparent when looking at the forecast for future launches. Worldwide, the number of space launches increased by 54%, from 74 launches in 2010 to 114 launches in 2020⁴. This trend is expected to continue through the 2020s, with The U.S. Federal Aviation Administration (FAA) Office of Commercial Space forecasting a further increase between 36% to 100% in the U.S. alone by the fiscal year 2025. Industry estimates are even higher with a fiscal 2025 growth of 177% over 2020⁵.

Thus, the two uncontrolled re-entry events and the risk they pose to aviation are noteworthy, given the strong global safety record the global aviation industry has worked so hard to achieve. Although neither event created an aviation-related casualty, several issues have been identified by ALPA that we believe are a global threat to aviation safety and need to be addressed by ICAO.

- The need for globally accepted standards for launch planning and recovery, as well as risk mitigation, should unplanned events occur during the launch and recovery.
- The need for globally accepted standards for space debris that at a minimum, includes “design for demise” requirements, as well as vehicle design requirements to ensure that very large pieces of space debris are controllable enough to ensure that the re-entry occurs at a pre-defined location and time.
- States need to greatly increase information dissemination before and during the re-entry events, so that aviation operations have adequate advance notice, as well as ongoing updates on the re-entry data as it becomes available. If necessary, actions by ANSPs should be taken so that aircraft are cleared from possible areas at risk to collisions from components that are falling through the airspace, during the re-entry.

Along with these suggestions, please accept our offer to provide the necessary personnel from ALPA to assist you in this activity. I firmly believe that ICAO is in the best position to immediately address this critical aviation safety issue. I stand firm in the belief that through collaboration and a common goal to achieve the highest possible safety levels, that the global aviation community can rise above the challenges we are currently facing, to the benefit of all humanity. I look forward to hearing from you soon.

Respectfully,

CAPT. JOSEPH G. DEPETE,
President, Air Line Pilots Association, International.

cc: Captain Jack Netskar, President of IFALPA
cc: Mr. Juan Carlos Salazar, ICAO Secretary General Effective August 1, 2021
cc: Mr. Sean E. Doocey, U.S. Representative to ICAO

Mr. LARSEN. Thank you, Captain DePete.

I now want to turn to Mike Moses, president of Virgin Galactic.

Mr. Moses, you are recognized for 5 minutes.

Mr. MOSES. Thank you, Chairman Larsen, Ranking Member Graves, Chairman DeFazio, and members of the Aviation Subcommittee and staff, for the opportunity to testify to you all today.

I am the president of space missions and safety for Virgin Galactic. I joined the company in 2011, following a career at NASA,

⁴ <https://www.spacelaunchreport.com/logyear.html>

⁵ https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Commercial_Space.pdf

where I worked on the space shuttle program, starting at Mission Control in Houston, and then eventually leading shuttle processing activities from the Kennedy Space Center.

My tenure there at NASA gave me perspective, insight, and experience for operations planning and safe execution of human spaceflight, which is my top responsibility here at Virgin Galactic.

Today, I would like to highlight the important policies that apply to Virgin Galactic and the commercial spaceflight industry that will help prioritize safety, while promoting growth of the industry.

Virgin Galactic was founded as the world's first commercial space line in 2004, with the ambitious mission of flying private astronauts to space. Our mission is to open frequent access to space, while safely delivering a transformative spaceflight experience to our astronauts.

Our system consists of two vehicles that take off and land on a runway rather than a launchpad. The mother ship is a purpose-built jet aircraft with the job of carrying the spaceship to a launch altitude at 50,000 feet. The spaceship launches from there and transports six customers and scientific research safely and routinely to space and back.

Our system is suborbital. So while we do not enter orbit around the Earth, our astronauts will experience several minutes of weightlessness as they float freely about the cabin, taking in the amazing views of Earth.

We have had three spaceflights so far, most recently last month. And our company's North Star is and always will be safety, a mindset that we know is shared throughout the commercial space sector and by my fellow panelists. In fact, we are immensely proud that our latest flight to space from New Mexico marks the 400th launch licensed by the FAA, maintaining their perfect public safety record.

The U.S. is a global leader in commercial spaceflight, and the industry has indeed seen significant growth in the past decade. The success is intentional, made possible by the leadership, decision-making, and action of the Congress and Federal agencies. Policies such as the learning period, informed consent, and risk-sharing liability regime have led the way for this explosive growth, without compromising safety or innovation. Now is the time to build on that solid foundation to ensure continued success, particularly as we now look to taking humans to space.

Commercial human spaceflight still is in its infancy. To date, we have only had Virgin Galactic's three suborbital missions and SpaceX's three human orbital Government missions that have flown humans.

A major step in building upon the foundation was the part 450 regulations to streamline into a single licensing regime. As Virgin Galactic and other companies work through these new regulations, we need to have the FAA with the resources required to continue its track record of excellent industry support in order to address unforeseen issues that may arise from this new regime quickly and in a manner that will not impact their protection of public safety nor delay commercial business.

On the safety front, the FAA regularly engages industry through an advisory committee called COMSTAC. As a current member of

that committee myself, I am proud to share that we work closely with the FAA on the development of voluntary industry consensus standards, including those related to human spaceflight. One such effort is via ASTM, who are actively developing and publishing standards.

Together, the industry is constantly innovating safety systems, designs, and operations. And while all this progress is beneficial, as noted earlier, the industry still is in its early days, and more time is needed to have informed discussions on what regulatory framework should look like in the future to support human spaceflight, looking beyond just public safety. Extending the learning period would allow these discussions to take place in Congress, in partnership with industry and the FAA.

Finally, as this committee is definitely aware, efforts to address our Nation's infrastructure and development and maintenance are underway, and space must definitely be part of that discussion. Protecting and improving that infrastructure is critical to life in the 21st century.

This is an exciting time, not only for Virgin Galactic, but for the entire industry, as we mark milestones towards human spaceflight. The committee's tireless work and progress on aviation and aerospace regulation is imperative and very much appreciated. We often call out the innovation that is occurring in spaceflight technology, but innovation can and should be applied to the policies that shape the sector as well.

We look forward to continuing to work closely with all of you in the pursuit of these highest levels of safety and innovation. Thank you for the time, and I am happy to answer questions during the Q&A.

[Mr. Moses' prepared statement follows:]

Prepared Statement of Mike Moses, President of Space Missions and Safety, Virgin Galactic

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

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

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

ABOUT VIRGIN GALACTIC

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

Our fleet is based on the historic SpaceShipOne vehicle—which was the first private space vehicle to safely carry human beings into space, which it did in 2004, claiming the Ansari X PRIZE. Virgin Galactic's vehicles were designed with the intention of opening frequent access to space and providing a transformational spaceflight experience to our astronauts. Our system is suborbital—it allows our astronauts to journey to space, beyond the Earth's atmosphere, and experience several minutes of floating freely about the cabin, out of your seat, experiencing zero-gravity and witnessing the incredible views of Earth from space. Our suborbital spaceflight system consists of two vehicles: Mothership (pictured in Figure 1) is a four-engine, dual-fuselage jet aircraft capable of high-altitude heavy lift missions. And our SpaceShip class of vehicles, which are suborbital spaceplanes carried by the mothership and designed to transport people and scientific research safely and routinely to suborbital space and back.



Figure 1: Mothership Carrier Aircraft, VMS EVE

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



Figure 2: SpaceShipTwo, VSS Unity

On March 30, 2021, Virgin Galactic rolled out our second spaceship and the flagship of the next generation of the SpaceShip fleet—SpaceShip III, *VSS Imagine* (pictured in Figure 3). *VSS Imagine* was manufactured in our Mojave, California, facility and will begin its flight test program this summer from Spaceport America—our operational headquarters in New Mexico—with powered flights following next year. As *VSS Imagine* begins its test program, manufacturing will progress on VSS Inspire, the second SpaceShip III vehicle, bringing the total number of spaceships within the Virgin Galactic fleet to three. The introduction of the SpaceShip III class of vehicles is an important milestone in Virgin Galactic’s multi-year effort that targets flying 400 flights per year, as these new vehicles were designed specifically to increase performance and reduce the time needed between flights.



Figure 3: SpaceShip III, VSS Imagine

INDUSTRY REGULATIONS

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

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

FAA LICENSING

Space Policy Directive 2 (SPD–2), released in 2018, called for the Executive Branch agencies to review existing regulations and ensure rules are not duplicative while continuing to promote economic growth, advance national security and foreign policy goals, and encourage U.S. commercial space leadership. In response to SPD–2, the Department of Transportation, through FAA AST, conducted a rulemaking effort on launch and reentry licensing for commercial space transportation vehicles. The new Part 450 regulations aimed to consolidate multiple regulatory parts to create a single licensing regime for all types of commercial spaceflight launch and reentry operations with the goal of replacing prescriptive requirements with performance-based criteria. Currently Virgin Galactic is operating under a Part 431 Operators License, originally issued on July 26, 2016.

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

THE LEARNING PERIOD

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

This learning period was initially enacted in 2004 to ensure that industry had time to develop and create a sufficient database of knowledge on which to base future commercial space regulations. Due to the technical and economic challenges of spaceflight and the industry’s emphasis on safety, commercial space companies did not progress as quickly as was once envisioned. Congress correctly acknowledged that the learning period did not fully accomplish its intended purpose and extended it—most recently with the Commercial Space Launch Competitiveness Act (CSLCA),

which extended it to Oct. 1, 2023. Before the learning period sunsets, Congress should work with industry to determine if sufficient experience, data, and metrics are available to define those areas most critical to regulate to meet Congress' public policy objectives.

In Title 51 U.S.C. § 50905(c)(6), Congress directed the FAA to submit a report specifying key industry metrics that might indicate a proper level of maturity for the commercial space industry to be fit for regulation. Section 50905(c)(7) of that same legislation also directed the FAA to submit another report every two years on "the commercial space activities most appropriate for regulatory action, if any, and a proposed transition plan for such regulations."

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

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

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

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

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

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

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

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

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

As a member of COMSTAC's Safety Working Group, I am proud to share that we are working closely with the FAA regarding the development of commercial spaceflight voluntary industry consensus standards. In September 2020, COMSTAC's Safety Working Group made multiple recommendations to COMSTAC

regarding this topic, highlighting the importance of this topic to everyone involved in our industry. We are currently focused on soliciting industry feedback to update supporting documents from FAA that industry will need upon conclusion of the learning period. Some of this information is almost two decades old and needs significant attention.

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

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

While all this progress has been beneficial, more time is needed to increase the overall standards framework. Given the diversity of vehicles and services within the industry, achieving helpful and applicable standards requires significant resources and collaboration. For human spaceflight alone, we have systems that launch vertically, horizontally, and even balloons that slowly ascend high into the atmosphere. With committees, advisory groups, and organizations actively working with the FAA to establish commercial spaceflight safety standards, the industry is constantly innovating safety systems, designs, and operations. Continuing informed discussions about the learning period is imperative to allow the industry and regulators to develop a safety framework that will best protect the health and safety of crew, government astronauts, and spaceflight participants while also ensuring our industry is the global leader in commercial space. It is without question that the learning period has enabled the commercial space industry to innovate for safety more quickly than they would if early regulations not based in industry data were in place. The learning period has given FAA the opportunity to collaborate with industry so that both FAA and industry are better able to achieve the highest levels of safety. Therefore, Congress should continue to engage with industry and the FAA to create a versatile regulatory framework that will optimize safety standards and maintain our current high levels of innovation.

COMMERCIAL SPACE INTEGRATION INTO AIRSPACE

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

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

SPACE SUPPORT VEHICLES

As mentioned earlier in this testimony, Virgin Galactic operates a hybrid vehicle system, consisting of both an aircraft and spacecraft. During operations when Virgin Galactic has no intent to launch, such as pilot training flights on our Mothership or glide flights without a rocket motor with our spaceship, we operate under a FAA-issued Experimental Airworthiness Certificate. Our Mothership is a unique aircraft that has an operating ceiling higher than typical commercial airliners. While Mothership's primary purpose is to support the launch of our SpaceShip, its unique capabilities have garnered interest from both the civil and national security re-

search community for alternative uses. While Mothership provides a unique platform, developed as part of a spaceflight system that is not accessible in typical commercial services, we are currently unable to support these communities' R&D without filing a petition for an exemption to the rule that restricts carriage of property (experiments) from compensation or hire. In addition to these research-related aviation activities, the Mothership also can support multiple other roles related to spaceflight activities, such as pilot and customer training and technology demonstration. In 2018, the Commercial Space Support Vehicle Act was passed as part of FAA Reauthorization bill which allows for Space Support Vehicle flights for hire, if the flight relates to launch and reentry purposes, such as training or technology development. We recommend Congress continue to encourage the use of "Space Support Vehicles" to allow for R&D only these unique vehicles are capable of.

INTERNATIONAL COMPETITIVENESS

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

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

SPACE AND SPACEPORT INFRASTRUCTURE

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

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

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

CONCLUSION

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

Mr. LARSEN. Thank you very much.

And I want to thank everyone for meeting the 5-minute timeline or beating the 5-minute timeline as well.

We are going to go now to Member questions, and we are going to start with kind of—going to reverse a little bit only to do a little bit of makeup from the first panel and because I ran out of Members to ask questions.

So I am going to first ask Representative Babin to be recognized for 5 minutes.

Dr. BABIN. You are very kind. Thank you very much, Mr. Chairman. I appreciate that.

I want to just say thank you very much to you folks for allowing me to come in here and to speak. I have got a definite vested interest in this from my district. But I want to say thank you, to begin with, Chairman Larsen and Ranking Member Graves, for letting me join your hearing today.

I have a question that I would like to ask of Mr. Moses from Virgin Galactic. So, Mike, if you are hearing, commercial human spaceflight operates under a regime known as informed consent. Spaceflight participants are made aware of the risky nature of spaceflight and undertake the activity full knowing those risks.

This is similar to skydiving, or BASE jumping, scuba diving, paragliding, rock climbing, big wave surfing, back-country skiing, and many other high-risk activities. And to further understand these risks, Congress prohibited the FAA from issuing commercial human spaceflight regulations so that the community could gather data from flights to inform future decisions.

The industry has not advanced as fast as it was assumed when this learning period was implemented, which has led to additional extensions to gather this necessary data. In the meantime, the industry has made progress on developing nonbinding consensus-based standards and best practices.

As you discussed a little bit, but also, can you further discuss how Virgin Galactic integrates these standards and best practices into your operations without the need for more regulations? If you could answer that, please.

Mr. MOSES. Sure thing, Representative Babin, I would be happy to. So I think it is important to maybe start by recognizing the framework that was originally built by the Commercial Space Launch Amendments Act back in 2004 by Congress itself is actually functioning exactly as designed. They innovated and came up with the policies of informed consent, of the learning period, and of other things. And the record has shown that launches have been safe, innovation has been fast and rapid, and things are progressing well. So I think it is important to just recognize how well things are working.

So that doesn't mean we stagnate there. We need to keep moving forward. I think the informed consent regime is an excellent tool that allows us, in this nascent stage of development, to be able to handle the risks that spaceflight poses to customers and to others while protecting the uninvolved public. And as a mechanism, it appears appropriate for now.

Eventually, you would look to a stage where commercial spaceflight transportation evolves to the scale of aviation, commercial aviation, where an informed consent regime is probably no longer necessary, but at this stage, I believe that is fairly relevant.

Virgin Galactic definitely takes the lead by joining industry with developing these standards that we are using, the voluntary consensus standards. And I think one of our challenges there is recognizing the diversity of types of vehicles being used. You have balloon launches, vertical launches, flyback boosters, horizontal launches, and space planes.

And while regulating the outcome of a system is definitely a performance-based regulation, definitely required, regulating the means of how you got that outcome can really stifle that development and kind of limit an operator from challenging themselves to find new ways to achieve that same safety level.

So I think these standards being done by industry are very valuable for now, and we need to continue to progress. I think we are definitely seeing, just like we see an increase in launch cadence, an increase in the maturity of those standards and readiness to head towards regulation with some of them.

Dr. BABIN. All right. Thank you very much. I really appreciate that, Mike.

I have the distinct honor of serving as the ranking member of the Space and Aeronautics Subcommittee of the House Science, Space, and Technology Committee. Before that, I was the chairman of the subcommittee for 4 years. And I also represent Johnson Space Center, the home of NASA's historic Mission Control. Because of this, I am keenly aware of the fact that the Department of Transportation plays a very important role in enabling American leadership and innovative industries like the commercial space launch industry.

The Science, Space, and Technology Committee has a long history of conducting thorough oversight of AST and the overall commercial space industry to ensure the safety of the uninvolved public and the sustained American leadership in this industry, just as this committee has a long and rich history of aviation oversight.

Going forward, the Transportation and Infrastructure Committee will play an important role in further enabling the integration of commercial space activities into the National Airspace System. Coordination by this committee with other committees of jurisdiction will certainly ensure that our Nation remains the leader in commercial space launch operations going forward. I trust that we all share these goals and look forward to coordinating efforts going forward.

And, with that, I would ask unanimous consent, Mr. Chairman, to add this entire statement. I didn't have time to read the entire statement. I want to introduce this for the record, if you don't mind.

Mr. LARSEN. Without objection.
[The information follows:]

**Prepared Statement of Hon. Brian Babin, a Representative in Congress
from the State of Texas**

I have the distinct honor of serving as the Ranking Member of the Space and Aeronautics Subcommittee of the House Science, Space, and Technology Committee. Before that, I was the Chair of the Subcommittee for four years. I also represent the Johnson Space Center, home of NASA's historic Mission Control Center. Because of this, I am keenly aware of the fact that DoT plays an important role in enabling American leadership in innovative industries like commercial space launch.

In 1984, House Science, Space, and Technology Committee leadership drafted the Commercial Space Launch Act, which authorized the Secretary of DoT to license private sector launch operations. Similarly, the Commercial Space Act of 1998, the Commercial Space Launch Amendments Act of 2004, and the U.S. Commercial Space Launch Competitiveness Act of 2015 reinforced and further fostered the growth of this industry.

While America's commercial space launch industry has demonstrated robust, safe, and reliable capabilities for several decades, leadership in the future will depend on innovation, adaptation, and evolution. That is why Congress tasked the Department with the dual roles of both regulating and promoting the industry, a tension that results in a balanced and measured relationship between the public and private sector.

It is also why Congress limited the Department's authority to protecting the uninvolved public, and why it mandated a learning period before promulgation of spaceflight participant regulations.

Independent advisory bodies have consistently recognized that space launch is an inherently risky endeavor. The *Columbia* Accident Investigation Board found that "... all human spaceflight must be viewed as a developmental activity. It is still far from a routine, operational undertaking." While great strides have been made, and the commercial launch of payloads appear to be increasingly more routine, the commercial human spaceflight industry is still in its infancy.

Additional regulations at this point would stifle innovation; export technology, talent, and tax dollars overseas; and undermine American leadership in space, which is a critical domain for national security in the future.

The FAA's Office of Commercial Space Transportation (AST) appropriately balances the goals of protecting the uninvolved public and ensuring the vibrancy of the U.S. commercial launch industry. AST has sufficient authority to fulfil its statutory direction to license and permit launches and reentries without the need for expanded regulations or the implementation of more draconian oversight requirements on license and permit holders. AST's compliance monitoring and enforcement is designed to modify licensee behavior to comply with federal safety regulations.

AST also has various enforcement tools at its disposal to ensure safety of the uninvolved public. Most notably, AST has the authority to prohibit future launches and rescind licenses. Recent actions by AST and licensees demonstrate the sufficiency of these existing compliance and enforcement tools.

The Science Committee has a long history of conducting thorough oversight of AST and the overall commercial space industry to ensure the safety of the uninvolved public and sustained American leadership, just as this Committee has a long history of aviation oversight. Going forward, the Transportation and Infrastructure Committee will play an important role in further enabling the integration of commercial space activities into the National Airspace System.

Coordination by this Committee with other Committees of jurisdiction will ensure that our nation remains the leader in commercial space launch operations. I trust that we all share these goals and look forward to coordinating efforts going forward.

Dr. BABIN. OK. With that, I yield back. And I just want to thank you again for your kindness.

Mr. LARSEN. Thank you.

The Chair now recognizes myself for 5 minutes for questions.

First question is for Captain DePete. Captain DePete, how long have you been a pilot?

Mr. DEPETE. I have been a pilot for 40 years, Mr. Chairman. I started out in the Marine Corps and then in the commercial airlines.

Mr. LARSEN. And in commercial airlines, what is the highest you have ever flown a commercial airplane?

Mr. DEPETE. Probably around 37,000 feet, 42,000 feet, somewhere in that range.

Mr. LARSEN. And how much higher than that does the FAA control the airspace?

Mr. DEPETE. Well, the positive control airspace goes all the way to 400, I believe.

Mr. LARSEN. OK, OK. So about 40,000 feet.

So, in your testimony, you mentioned yourself as a pilot. You mentioned air traffic control and air traffic controllers, all these folks who are involved in the airspace currently, as well, not just involved, but ensuring that it is operated safely. Is that about right?

Mr. DEPETE. That is correct.

Mr. LARSEN. So you also highlighted systemic space integration strategy. And my opening comments for this particular panel were about the airspace between the ground and getting to space, the FAA does need to have a positive control of that. And integrating these launches through that airspace that is already being used is pretty critical, and it seems the FAA has a role in that.

Mr. DEPETE. Absolutely.

Mr. LARSEN. So getting back to Representative Babin's statement about coordination between committees, I think is absolutely right on, very critical, but also shows the need for the committee here as well to ensure that the FAA's—and FAA's safety mission—has a place in these discussions as we move forward. Would you agree with that? Am I off base?

Mr. DEPETE. I would, sir. And I believe, you know—I have got experience on the NAC and the DAC. I don't belong to the COMSTAC. But I found it rather ironic that we are—you know, our goal is to end segregation and enter into a time period in the future where we have full integration, yet the individual committees actually do their work relatively segregated. So it is my—

Mr. LARSEN. Can I just comment? I wrote a note from Representative Babin's statement. That stovepipe, you know, jurisdiction goes well past our time here in Congress, Representative Babin, and probably we do need to sort that out.

So thank you, Captain.

I want to go to Mr. Bruno. Your testimony references the update to the licensing process that the FAA began in 2018. And you applaud the FAA for streamlining the rules.

How have these changes in rules directly impacted ULA launches in terms of timing and frequency?

Mr. BRUNO. Yes, I would like to acknowledge the collaboration approach that the FAA has taken with industry. They have, as has been mentioned before, shifted from a prescriptive set of requirements to obtain a license to one that is performance-based, and this has allowed us to achieve the safety that they identify by different means, more efficient and responsive to our customers' desires.

Again, the safety standards are [inaudible]. We have been given the freedom to innovate to achieve it.

Mr. LARSEN. Your testimony also makes mention of the thousands of suppliers and partners that you partner with in the U.S. And we have made and I have made support for the aerospace workforce a priority for the subcommittee.

What can the subcommittee and DOT and FAA be doing to encourage growth in this specific portion of the supply chain?

Mr. BRUNO. That is a great question, sir. It takes many, many people to design and build a rocket. We would like to see as much of that content done domestically in the United States. It protects us, not only in terms of our workforce and our talent, but also in terms of our intellectual property, an environment where China has shown significant aggression in acquiring intellectual property, not only through what you might think of as traditional means, through hacking or old-fashioned espionage, but more often now through economic means, by infiltrating the supply chain, by purchasing companies outright or by investing in companies in order to achieve influence and access to their intellectual property and ours.

So I would ask Congress to create a means for allowing it to be more robust in keeping China out of that supply chain.

Mr. LARSEN. OK. Finally, I have run out of time, but I am going to just take a prerogative here. At the beginning of the hearing several hours ago, in my opening statement, I mentioned the importance of diversity in aviation, the diversity in aerospace, and the diversity that we ought to be seeing in commercial space as well.

In the future, this committee will be doing a hearing on diversity in the aerospace workforce. And whether or not any of you all are requested to be on the panel, I do want you all to take a hard look at whether your company or representing industry, or in the case of Space Florida, a public corporation as you see yourselves, I want you all to take a hard look at the actions you are taking to increase the diversity within the aerospace workforce, especially as it applies to your portion and commercial space, and offer that written testimony to the committee so—again, if you are not on the panel itself.

And I hope you do take advantage of that opportunity. It is critical. The demographics of the United States are changing, and we need to change with it and we need to ensure an access opportunity in these growing industries throughout the country, and we need to do our part.

So, with that, I want to now recognize Representative Graves of Louisiana for 5 minutes.

Mr. GRAVES OF LOUISIANA. Thank you, Mr. Chairman.

Mr. Chairman, I want to ask a question of Mr. Bruno. Chairman Larsen and I recently introduced the Aerospace Debris Safety Act, which tasks the FAA with various missions, including tracking re-entering space debris and working to mitigate the risk to aircraft operating in potentially hazardous airspace.

Have you seen the legislation, and can you offer any feedback to us on that?

Mr. BRUNO. I have, sir. And I want to commend your leadership on this. This is an excellent first step.

What we want to appreciate is that we have talked about overload debris and reentry for many years, but it was always tomorrow's problem. With the implementation of our first mega-constellation in LEO, I can tell you that that problem has arrived today.

The quantity and frequency of orbital debris reentry in the coming months and years will increase by at least a factor of 10. And so this legislation that asks the FAA to significantly increase the precision and availability of tracking data will allow us a very, very important tool in now space- and air-integrated traffic management.

Mr. GRAVES OF LOUISIANA. Thank you.

Mr. Moses, you note in your testimony that you agree that regulatory standards governing human spaceflight must evolve as the industry matures so that regulations neither stifle technology, innovation, development, nor expose the crews to avoidable risk.

What do you believe is the best way to meet that objective?

Mr. MOSES. Well, I think one of the things we have recognized in our work with COMSTAC and industry is that trying to acquire a one-size-fits-all set of standards or implementation will prove to be very challenging for implementation.

An example there is just within our own system. We use horizontal stabilizers and vertical stabilizers like an aircraft would, which don't exist on capsules or vertical launch rockets. And so standards that apply to one don't necessarily apply to another.

So step back for a second and find those common areas where you do have that commonality. Propellant handling, ground systems, environmental control systems, those are common across most vehicles. So let's start with those standards, get agreement on those, get industry sharing, industry reporting, start with regulation there.

And so I think a "one bite of the elephant at a time" type of approach is the right way to get standards into the mainstream.

Mr. GRAVES OF LOUISIANA. Thank you.

Mr. DiBello, in your testimony, you talk about commercial spaceflight as effectively being a form of transportation. And there is a line in your testimony where you say: "Space Florida urges an increased FAA effort in technology development and deployment to advance the safe and efficient integration of routine space transportation with commercial aviation."

Could you comment on that a little bit and how you see that relationship, I guess, evolving? As I mentioned in my opening statement, you have just seen an extraordinary increase in the number of commercial spaceflights.

Mr. DiBELLO. Certainly. We have seen both an increase in the number of spaceflights, but, more broadly, as we look at the horizon for the future, we are seeing an increase in the types of platforms that will be flying. And commercial industry is introducing and advancing technologies very rapidly and adapting them very rapidly.

So what we are seeing with respect to integration in the national airspace is that we need to take advantage of the capabilities that can be put into the vehicles themselves to know where they are and the increases in safety, the diagnostics, knowing what is hap-

pening to the platform on the fly so that many of those things can be fixed on the fly as software fixes, and take advantage of those to inform what we are doing as they transit the airspace.

The second is awareness and communications. We have the capability today to significantly improve communications and awareness of what is happening in spaceflight so that we can effectively narrow the launch window, the time in which the launch space has to be closed.

And there is no reason why—as an example, a vehicle gets to 60,000 feet oftentimes in anywhere from 90 seconds to 2 minutes, but returning, it passes through the airspace in 60 seconds. So there is no reason in the world why we can't more effectively integrate, use the data system, the space data system that General Monteith is putting into place, and work with much narrower windows to increase the volume of both launches and the ease on the air traffic control system.

Mr. GRAVES OF LOUISIANA. Great. Thank you.

I yield back, Mr. Chairman.

Mr. LARSEN. Thank you.

The Chair now recognizes Representative Brown of Maryland for 5 minutes.

Mr. BROWN. Thank you, Mr. Chairman. I appreciate your holding this hearing on this very important topic today. It has been a long day, and I thank our participants, our panelists for sticking in there with us.

Like you, Mr. Chairman, I too believe that Congress and, more specifically, the Transportation and Infrastructure Committee, plays a critical role in the future of the emerging commercial space industry as well as in ensuring our national security. I also see the FAA playing a critical role in both of those as well.

Mr. Bruno, you mentioned—so my question is for you—in your written testimony that, and I quote from your written testimony: “Foreign governments and multilateral organizations also have important roles to play. The United States does not have a monopoly,” you wrote, “on satellite constellations, and accordingly, the existing international rules of conduct for space activities must be revisited and new ones considered for this burgeoning area,” and “it is profoundly in the interest of the U.S. Government to lead the way in confronting these issues with the invaluable work of the FAA.”

Can you expand on the importance of the FAA's role in international cooperation and protecting access to low Earth orbit?

Mr. BRUNO. Yes, sir, absolutely. It is important to understand that space is a global commons. What any actor does in space affects all of us. Satellites orbit the entire Earth. They do not stay only over our airspace.

We are seeing the first large impacts of the new proliferated LEO or mega-constellations that promise such great benefits to us but also present these new challenges. For the first time, we have a constellation on orbit which is physically dense and will impact our launch access to orbits that are just above or just adjacent to it.

China has also announced plans to place a similar constellation in orbit which is several times larger. So not only will we need to be concerned about our own industry and our own operators behaving in a responsible fashion, we must have agreements, inter-

national agreements and standards of behavior that we all abide by, especially our peer competitors, potential competitors like China as well as other countries.

I would also want to add, building on something Mr. DeFazio introduced, that yes, we have seen a very large increase in launch rate recently. I would want the committee to understand that that increase is almost entirely due to lifting the current mega-constellation which is now being populated in orbit. And then each of those extra, if you will, launches carry dozens and dozens of spacecraft.

So while we have a concern with air traffic during ascent, we have a much more physically crowded region within what we traditionally already call the congested space in LEO, which will lead to a very high rate of deorbiting spacecraft in just a handful of years as they begin to reach the end of their life.

Mr. BROWN. So, Mr. Bruno, as you consider how to best protect the orbital environment, the orbital environment through tools such as space situational awareness, two questions: What are some of the factors you consider, and what is the significance to national security in not having a robust Federal Government presence?

Mr. BRUNO. I will answer the second part first. We pass through this lowest layer, this relatively dense now shell of LEO spacecraft to carry our national security payloads to do their vital work for the United States. If we can't lift them to space, they can't do their work. It is literally that simple.

And in terms of how we manage that problem, we will need to manage the physical density of these constellations. We are going to require more precise tracking that is near real time of where the objects are. That will require cooperation from the operators, because these spacecraft often have the ability to autonomously move in their orbit to avoid colliding with one another, which is a good thing, but we can't leave the Air Force and Space Force to simply monitor and hope to notice the movements and then later reposition where they think they are.

And then, finally, we really truly need these operators to plan on controlled deorbits. It is not just the issue of how many things are deorbiting through the airspace, it is also important that they be controlled so that they do not reenter in a way that can harm the public, but also so that they reenter in a predictable way.

A controlled deorbit is steep, rapid, predictable, precise, and known in advance. An uncontrolled deorbit is a wide-sweeping arc that has great uncertainty all the way down to impact. So we need those things, in cooperation, between [inaudible].

Mr. BROWN. Thank you, Mr. Bruno.

Mr. Chairman, I yield back.

Mr. LARSEN. The gentleman's time has expired.

We are going to go with Representative Van Drew. Is Representative Van Drew up?

Yes. There you are. Representative Van Drew, you are recognized for 5 minutes.

Dr. VAN DREW. Good afternoon, everyone. Thank you for appearing before the Subcommittee on Aviation to discuss the exciting area of commercial space.

The United States has been leading space exploration since the very beginning. Whether we were landing on the moon, or building a global satellite, telecommunications network, our country has accomplished incredible goals in space.

We find ourselves in a new era of American leadership in space. American development of reusable rockets offers the potential for far more efficient space exploration, and even civilian passenger transportation. As this new industry grows, we need to ensure that it is properly meshed with the existing national airspace. Safety needs to be the absolute, the absolute top priority in everything that we do.

In that line, I have several questions for Captain DePete of the Air Line Pilots Association. First of all, if you had just one recommendation on a single action that the FAA should take in order to support space operations into the future, what would that one action be?

Mr. DEPETE. Thank you for the question.

Without a doubt, that is an easy one for me. It would be to pull together the individual committees of the NAC, the DAC, and the COMSTAC that deal with the airspace users and meld them into a single advisory integrated system.

Currently right now, much of the work is being done segregated. There is very little topic matter being discussed in those committees regarding commercial space, except in the COMSTAC, and I think that would go a long way, because together with that, I think it would lead towards more of a development of a safety culture, which I think is the beginning to really reaching full integration.

Dr. VAN DREW. Well, thank you. And that sounds like a good recommendation, by the way.

Does the FAA give pilots information about space debris that may be entering the atmosphere above them as they are actually flying through the air?

Mr. DEPETE. No, sir. And thank you for bringing that up.

Look, our number one priority of my members is safety. That is what our union was founded on. They have the regulatory responsibility and the professional duty to ensure the safe conduct of a flight, and it is absolutely essential, they have a need to know about the areas of risk that they enter.

Currently standing right now, other than NOTAMs, which is another whole subject—I know Representative Stauber has a lot to say about those as well, and so do we, but there isn't really any kind of real-time information, and it is hard for a pilot in command to make informed decisions without being aware that he may be entering an airspace that is elevated in risk. So, it would be very helpful. We really need to tackle that problem.

Dr. VAN DREW. Any sense why they don't do it?

Mr. DEPETE. Well, I will let the FAA—

Dr. VAN DREW. Answer for themselves? Right?

Mr. DEPETE. Well, I just believe there is a lot of low-hanging fruit out there that could be used right now help do it. I know that the SDI was mentioned, the Space Data Integrator recently, previously on the first panel, and one of the frustrations that I have is that currently the data that comes from the SDI, after many years, I mean, this is a known problem, it has to be manually en-

tered into the air traffic controller's screen to enable them to do that, to pass the information along to us. That needs to be automated. That is an easy one. I think that is a pretty easy fix, and I think we could fix that, and that would go a long way.

Dr. VAN DREW. Good.

One more. I have heard you talk about safety management systems for the airlines several times. Do commercial space operators use safety management systems as well?

Mr. DEPETE. No, sir, but they absolutely should. And, again, I don't think you can get there from here, unless you do that, and if you really—if you are targeting full integration, the thing about a safety management system is—I think we should talk about safety culture first, because that is the part that has—that is the foundation, and that is the way safety is perceived, valued, and prioritized within an organization from the top on down. And it empowers people to report issues, to communicate freely about safety issues. It affects the attitudes and the beliefs and the behaviors, and that is the foundation for a safety management system, which is a more formalized adoption through tools and procedures for a structured safety program.

So without that, that is how the airlines got into the situations where they are right now, and why our system is so safe.

Dr. VAN DREW. Good, which is what we want. Safety is number one.

Mr. DEPETE. Yes, sir.

Dr. VAN DREW. Captain, I appreciate your testimony.

Mr. DEPETE. Thank you.

Dr. VAN DREW. And, Chairman, I yield back.

Mr. LARSEN. Thank you, Representative Van Drew.

The Chair now recognizes Representative Johnson of Georgia for 5 minutes.

Representative Johnson, you are recognized.

Mr. JOHNSON OF GEORGIA. Thank you, Mr. Chairman, for holding this hearing, and thank you to the witnesses for your time and your testimony.

"The cosmos," as Carl Sagan once said, "is all that is or ever was or ever will be," end quote. Today, our curiosity about the cosmos has led us to pursue human spaceflight, adding to the lexicon words like "spaceport" and "orbital debris." As we embark on this new frontier, we must prioritize safety, equitable access, and diligently pursue limited environmental impact.

Mr. DiBello, as the single point of contact for State aerospace-related activities, Space Florida is, in many ways, a gatekeeper to space industry businesses. Your testimony states that part of your mission is to support infrastructure development and enable growth of commercial space companies.

Has Space Florida made a concerted effort to engage historically disadvantaged businesses? And, if so, what has come of that engagement?

Mr. DiBELLO. Most certainly we have. And I can tell you that we engage regularly, just as we lead with infrastructure for the commercial companies, we also are concerned with the whole ecosystem that supports the development of spaceport and spaceport operations.

A key element of that is the workforce. So we put a lot of effort into working with the State university system, the community colleges, the technical trade schools, and ensure that programs exist, whether they be curricular focused on needed space skills, and, first of all, that they exist; and, secondly, that they are really open to the variety of constituencies that really want to work in the space field.

Mr. JOHNSON OF GEORGIA. Well, I think I would like to ask, what steps will Space Florida take to ensure that minority-owned and women-owned businesses are not disadvantaged in accessing the enormous opportunity and resources that the new commercial space industry presents?

Mr. DiBELLO. Well, I can tell you that the industry recognizes that women and minorities oftentimes make up better than 50 percent of the classes that we look at in the universities, community colleges—

Mr. JOHNSON OF GEORGIA. Well, I am talking about businesses.

Mr. DiBELLO. I understand.

Mr. JOHNSON OF GEORGIA. I am talking about money now.

Mr. DiBELLO. Yes, but the businesses recognize that many of those students are in the upper third of their class. So we engage actively in building training facilities and infrastructure that can, in fact, be industry-guided to attract those students into their workforce, and give them a hand, a direct hand on acquiring the kind of talent that they need—

Mr. JOHNSON OF GEORGIA. Right. Thank you, sir. I want to move on.

Mr. DiBELLO. It is in their best interest to do that. Please.

Mr. JOHNSON OF GEORGIA. I want to move on to my next question. Thank you.

Mr. Moses, at NASA you played an integral role on spaceship missions during ascent, orbit, and entry operations. As such, you must have had an unparalleled insight into the experience of astronauts, many of whom are changed by their travel to space. One such change is a new-found appreciation that humans are earthlings above all else.

Can you please speak to how the ability of everyday humans to travel to space could allow us to reimagine ourselves beyond racial, economic, and nationalistic divisions, and see one another as, first and foremost, human?

Mr. MOSES. Representative Johnson, that is an amazing question. You have written one of the tenets of our company's foundational values.

We really believe the opportunity to go see Earth from space, witness no borders, no boundaries, the thin boundary of the atmosphere, the fragility of the Earth's ecosystem, and that we are all humans on one planet headed in one direction is a really transformative experience. And the more people that can experience that, they will bring back to their daily lives, they will integrate that into their culture, their business dealings, their education, and soon, we will become a space-faring nation, a space-faring global economy, and a people that will look past those differences and see the commonality.

Mr. JOHNSON OF GEORGIA. OK. I thank you for that answer.

Mr. Bruno, your testimony makes reference to the geopolitical dynamics at play in the human spaceflight industry.

How can the [inaudible] further bolster its presence in spaceflight while mitigating and [inaudible] competition and fostering collaboration?

Mr. BRUNO. Sorry, sir, I lost your audio at about the word “mitigate.”

Mr. LARSEN. I am sorry. This is the chair, Mr. Johnson. Your time has expired. But if you could get that question to the committee, we can get it to Mr. Bruno for the record.

Mr. JOHNSON OF GEORGIA. All right. Thank you, Mr. Chairman.

Mr. LARSEN. Thank you.

The Chair now recognizes Representative Steel of California for 5 minutes.

Representative Steel, you are recognized.

Mrs. STEEL. Thank you, Chairman Larsen and Ranking Member Graves, and thank you for all of the witnesses staying late today and joining us and really appreciate it.

Southern California and California as a whole has a long history in aerospace and continues to be a leader in this field. Today, as we look to the near future, my State and private-sector entrepreneurs, businesses, and manufacturers in aerospace are making great progress on the innovative technologies that will continue to radically transform commercial space travel.

The FAA plays an important role in encouraging, facilitating, and promoting the commercial space transportation industry, while ensuring safety through permitting and licensing. I believe we must continue to work to take advantage of the innovations being achieved by private-sector entrepreneurs to lead us into the future of spaceflight by ensuring efficiency in permitting, while also protecting the safety of our communities and that the innovation in this field will help advance the entire aviation industry.

My first question was, the Biden administration requested a \$5 million increase in the budget for the operational account for the Office of Commercial Space Transportation, but General Monteith already answered that.

So I am going to go straight to the second question to all of the panelists, how might commercial space research and development be used to add ongoing aviation R&D, and enable future high-speed aviation and transportation solutions and means connecting between both learning and commercial space R&D and regular traditional aviation, and how they can work together where they can find the common ground to improve across all types so we can make flights faster, and how are we going to do this so that we work together?

Mr. BRUNO. I will start, Representative Steel, by saying that the FAA has already started on a track of very good and productive collaboration with industry on solutions that are performance-based, and that will be a significant enabler of that activity.

There is one other point I would like to make relative to General Monteith’s earlier testimony on talented workforce, where he talked about the need to have a close relationship with industry and with universities so that there is adequate talent within the FAA to do their mission. I would hope that the committee would

understand that this problem is more difficult than simply STEM, and simply having engineers who move into the aerospace profession, and some of them going into the FAA. The safety discipline within rocketry is highly specialized, highly narrow, and there is a limited number of personnel across the industry and within the FAA who have those skills that are not taught in the universities, but, rather, taught in industry and at the FAA. And anything that Congress can do to support the FAA's opportunity to develop and attract that talent will benefit all of us.

Mrs. STEEL. Thank you.

Mr. MOSES. And, Representative Steel, I will be happy to maybe address how the technology innovation between spaceflight and aviation potentially marries in the future and highlight what my fellow panelists and other members of the subcommittee have highlighted, that the integration of the airspace into a single common user, single common source, is highly critical for that.

You can imagine a system—one of the reasons our company pursues horizontal launch from aircraft is we see a much simpler integration into the airspace for future transportation of high-speed systems. And, so, getting those steps made now for how airspace is deconflicted, times are kept short, interactions are made very efficient, is critical for those future innovations and technology developments for aviation.

Mr. DEPETE. I would like to—

Mr. DiBELLO. I would like to, if I may—

Mr. DEPETE. Go ahead.

Mr. DiBELLO [continuing]. Add to that if I can.

In response to the question, clearly, the industry has been advancing technologies across the world. Space is hard, and as we advance technologies which enable us to do things in space, many of those do flow across a horizontal industry and infuse themselves into what we know about aviation. But the big advantage is the fact that space assets have become increasingly more vital to management of not only our airspace, but things in space to things in the air, things on the ground and in our back pockets, that this integration that is occurring and connectivity that is occurring and the amount of data that are being gathered by the thousands of satellites that are now up there and will be put up there will enable them to have access to the data and the awareness and communications mechanisms that it needs to fully integrate the space and air together.

Mr. LARSEN. The Representative's time has expired.

Mrs. STEEL. Thank you. I yield back.

Mr. LARSEN. Thank you very much.

I want to thank the panel for joining us today and thank you for your patience. I won't apologize for Congress exercising its basic constitutional duty of voting today. I know it was inconvenient for you to wait around. But I guess the payoff is the value of your testimony was very important, is very important for us, as we continue to look at ensuring the safe integration of commercial space into a very busy FAA-controlled airspace.

So with that, again, I want to thank the panel and each of the witnesses. I ask unanimous consent that the record of today's hearing remain open until such time as our witnesses have provided

answers to any questions that may be submitted to them in writing. I also ask unanimous consent that the record remain open for 15 days for any additional comments and information submitted by Members or witnesses to be included in the record of today's hearing.

Without objection, so ordered.

And with that, the committee stands adjourned.

[Whereupon, at 6:37 p.m., the subcommittee was adjourned.]

SUBMISSIONS FOR THE RECORD

Prepared Statement of Hon. Sam Graves, a Representative in Congress from the State of Missouri, and Ranking Member, Committee on Transportation and Infrastructure

Thank you, Chair Larsen and Ranking Member Graves, and thank you to our witnesses for being here today.

I'm pleased the Chair has called this hearing to discuss FAA's oversight of the commercial space transportation industry.

Although this sector has only existed since 1984, it has reshaped our national economy and changed the way we think about the future of transportation.

With 12 licensed commercial launch and reentry sites, 24 launch and reentry licenses issued, and 46 authorized experimental launches conducted just during Fiscal Year 2020 to 2021, this is an exciting time of progress and innovation in this sector.

As commercial space transportation grows in frequency and diversity of operations, it is critical that this committee continue to exercise oversight over the FAA to ensure it is fulfilling its responsibilities as the regulator and airspace manager.

I look forward to hearing from our witnesses about how they think FAA is doing when it comes to overseeing this expanding aerospace sector, planning for safe and growing airspace integration, and what lies ahead in maintaining our competitive advantage.

Thank you, Chair Larsen. I yield back.

Prepared Statement of Hon. Eddie Bernice Johnson, a Representative in Congress from the State of Texas

Thank you, Subcommittee Chairman Larsen and Ranking Member Graves for holding today's hearing and assisting our committee to examine in an in-depth manner the future of the U.S. commercial space transportation industry, and the role of the FAA in overseeing and regulating this rapidly expanding industry. I would also like to thank our outstanding witnesses for testifying before us today.

Today's hearing is a topic of considerable interest as commercial spaceflight is a growing sector of our nation's civil space activity.

Our discussion this afternoon is important in informing the Transportation and Infrastructure Committee's oversight of the national airspace system, given that both government and commercial spaceflight must coordinate their flights through the national airspace system.

The FAA's role in the safe integration of new entrants into the airspace system is of heightened importance. Commercial spaceflight activities are expected to increase, along with those of aircraft systems without a crew. In addition, urban air mobility and advanced air mobility will also come online in the future. To that end, I'm pleased that the FAA and NASA have a strong partnership on research and development to facilitate the safe integration of these systems into the airspace system.

Commercial spaceflight is a topic with which I am very familiar. The Science, Space, and Technology Committee that I chair has jurisdiction and oversight over commercial space, commercial space transportation, and the FAA's Office of Commercial Space Transportation. I'm pleased that the legislation this committee passed 37 years ago with the "Commercial Space Launch Act," and its many updates and amendments, have led to the development of a safe, growing, and successful commercial spaceflight industry. The statute includes regulation of third-party safety and a shared government-industry indemnification and liability regime.

Growth in commercial spaceflight is leading to opportunities and challenges that the Committee on Science, Space, and Technology will be reviewing, particularly at

this time given that commercial human suborbital and orbital spaceflight are now on the verge of being realized. With those developments, as chair of the Science, Space, and Technology Committee, I plan to lead the committee into taking an active role in considering relevant policy on commercial human spaceflight safety, and hope to partner and work in close collaboration with my colleagues here today on the future of commercial spaceflight policy and address some of the serious challenges, including safety and others, that the industry faces as outlined by our witnesses today.

Statement of Nicole deSibour Rodgers, Executive Director, 200 Mile Gateway, Submitted for the Record by Hon. Brian J. Mast

Chairman Larsen, Ranking Member Graves, and distinguished members of the Committee, thank you for accepting the 200 Mile Gateway's submission of our views on the role of the FAA in the future of the U.S. commercial space industry.

The 200 Mile Gateway is a not for profit organization promoting the investments and infrastructure of the aerospace and defense industries in the 200 Mile Gateway region that stretches from Jacksonville, Florida to Charleston, South Carolina. This region is rich with commercial space interest and history. Back in the 1960s, the world's most powerful rocket motor was fired in Camden County on the proposed site of Spaceport Camden (license expected this summer). Our region is also home to Cecil Spaceport and is proximate to Cape Canaveral. We are also home to fourteen military installations, more than 30 airports (including 4 commercial airports), four major ports, two commercial railroads and sit directly on the I-95 corridor.

As we look to the future of housing both a horizontal and a vertical spaceport in our region and serving the larger commercial space industry given our synergistic proximity to Cape Canaveral, we share the Committee's interest in the role that the Federal Aviation Administration (FAA) must play in the future regulation and oversight of the emerging and booming commercial space industry. We must be forward thinking, responsible and innovative. The FAA must retake its ownership over the regulation and management of commercial space in order to be the responsible steward of both progress and the National Air Space (NAS).

I: STEWARDSHIP OF THE NATIONAL AIR SPACE REQUIRES INNOVATION NOT JUST INCREASED HEADCOUNT:

One of the most important roles of the FAA oversight of commercial space in the near term is NAS Integration and reducing the amount of air space and duration that must be closed during each licensed launch. I think we can all agree that the current model of air space closures is not sustainable. FAA-licensed (FAA) launches cause a significant impact to our aviation industry:

- In FY 2017, about 1,200 commercial airline flights were directly affected resulting in additional 39,000 miles.¹
- Single space launches resulted in 3,000 total minutes of delay per launch.
- Airlines currently estimate the delay cost to the airline at \$74.20 per minute²
- The direct cost to airlines is \$222,600 per launch.
- Adding the additional cost of lost productivity time at \$49 per hour there is another \$245,000 in economic costs imposed on the competing airspace users.³

The FAA must look at all options for addressing NAS Integration with an open mind and, we, the 200 Mile Gateway, believe that merely increasing headcount and funding is not the solution. Currently the FAA is exploring two technology strategies for managing NAS Integration—the Space Data Integrator (SDI) and Hazard Risk and Management (HRAM). SDI follows old models of the way the FAA has always done things and assumes the telemetry data analysis and vehicle tracking must be done at the agency level thus justifying increased headcount. However, SDI requires companies to feed significant amounts of raw proprietary data to the FAA SDI during each launch so that the analysis can then be run. By contrast, an HRAM model allows companies to protect the integrity of their vehicle design data, be continually running analysis and feeding HRAM information directly to the ATC and into the cockpit of every air craft.

¹GAO Report 19-437, Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth, May 2019, p 34.

²Airlines for America. (2019). U.S. Passenger Delay Costs [online]. Available at: <https://www.airlines.org/dataset/u-s-passenger-carrier-delay-costs> (Accessed: 26 November 2019).

³Tinoco, Janet K., et al. An Introduction to the Spaceport Industry: Runaways to Space. Routledge Taylor & Francis Group, 2020, pg 12.

- HRAM is a prototype tool to aid in improving the efficiency of the National Air-space System around launch and reentry vehicle operations.
- The concept focuses on integrating Space Vehicle and aircraft operations, rather than segregating them.
- HRAM enables reactive separation (if pilots see a dangerous situation they can avert) in the case of vehicle failure.
- The tool is designed to automatically interface with other systems: space vehicle data as input and air traffic systems as output.
- It thus incorporates logic to appropriate process and maintain state (common knowledge of complex space missions during flight).
- Within seconds, the tool computes the hazard volumes associated with a failure, accounting for potential lack of information of failure response.
- This allows real-time aircraft maneuvering to avoid an actual debris field, instead of segregation from the area where a debris field may occur.

II: FAA MUST INNOVATE TO ANTICIPATE

Innovators in the commercial space industry have made reusability a priority in the future of rocket development. The recent out of control Chinese rocket that created panic in all those managing the worldwide airspace further highlighted the need for the United States to lead on innovative tools to predict and track both rogue and planned re-entries to mitigate risk.

Fortunately, one of the tools already being examined for NAS Integration can do just that. HRAM has the capacity to more accurately and precisely predict reentry points allowing for more accurate air space management and risk mitigation. We have included with this testimony a video demonstration of HRAM's predictive capabilities. The AST is stretched thin as it is and managing the anticipated increase in scheduled launches plus adding the management of re-entry for each launched rocket will far exceed current capabilities and capacity. Leveraging HRAM technology will help improve efficiency and workload management for AST, improve safety, mitigate risk, reduce the impact of costly air space closures and ensure that the ATC, pilots and launch operator all have the same information in real time.

- Since 2012, licensed activities increased 1,000% and AST's budget and staffing increased roughly 40 percent.
- Moreover, we are now looking at another potential increase of 100–500% in commercial launch activity by 2021 while our staff may only increase about 20 percent.
- Making this period even more interesting is the significant uptick in the complexity and variability of proposed launch and reentry vehicles.
- We also expect a commercially viable human spaceflight participant landscape involving space tourism that could lead to 100+ flights per year.

III: PROMOTING A TRULY PRIVATE SECTOR COMMERCIAL SPACE INDUSTRY—FAA SHOULD LICENSE ALL ASPECTS OF COMMERCIAL SPACE LAUNCHES

The second critical area that FAA must prioritize in order to responsibly steward growth in the commercial space industry is to reclaim oversight responsibility over launch and range operations. The FAA must provide an avenue for private sector service providers to enter that market by creating a regulatory licensing and vetting protocol allowing for such companies to offer their services as an alternative to the Air Force. The current system of commercial launches being managed by the Air Force on an as-available capacity is unsustainable and contrary to U.S.C. 51. As section 50501 of U.S.C. 51 states “the availability of commercial launch services is essential for the continued growth of the United States commercial space sector.” As the National Space Program continues its own growth trajectory and the Air Force must prioritize its resources and efforts there-in, the Air Force cannot be the only option for commercial launches or it will stymie growth in that sector. Additionally, providing a path for private sector launch operations ensures compliance with section 509 of U.S.C. 51 (see appendix), enhances the viability and attractiveness of the additional commercial spaceports the FAA has and will license that are not co-located with Federal Ranges. We also encourage this committee and the FAA to expand the use of the ODA vetting and licensing process to the commercial space sector to allow for vetted launch and range operators to support the AST in meeting their 180 day launch license issuance requirements by authorizing private sector review and approval of license applications according to the stringent ODA process. We encourage the FAA to incorporate the recommendations of the Department of Transportation Inspector General's office with regards to future ODAs when establishing a protocol for commercial space.

Mr. Chairman, Mr. Ranking Member and Members of the Committee, thank you, again, for the opportunity to share testimony with you on the priorities for the FAA in commercial space. The 200 Mile Gateway is excited and energized by the growth, innovation and opportunity in this sector and the opportunity it provides for the companies, employees and citizens in our region. The commercial space industry should be appropriately regulated and licensed to be a vibrant private sector and the FAA should look to innovative technology solutions and private sector partnerships to improve safety and meet the demands of the future rather than hold on to historic modus operandi. We look forward to serving as a resource to the Committee, the FAA and the industry in promoting opportunity and improvements in the commercial space sector.

APPENDIX:

HRAM Background and Demonstrations:



Legend
Yellow Icon—location of object at predicted reentry time
Orange Line—area of visibility at the predicted reentry time for a ground observer
Blue Line—ground track uncertainty prior to predicted reentry time (ticks at 5-minute intervals)

Yellow Line—ground track uncertainty after predicted reentry time (ticks at 5-minute intervals)

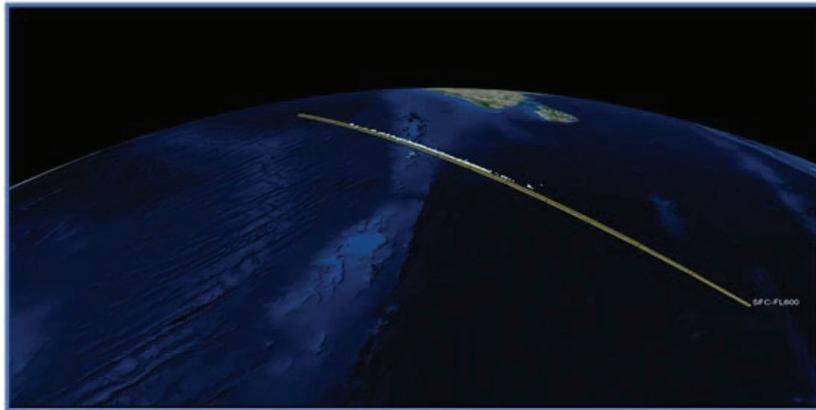
White Line—day/night divider at predicted reentry time (Sun location shown by White Icon)

Pink Icon—vicinity of eyewitness sighting

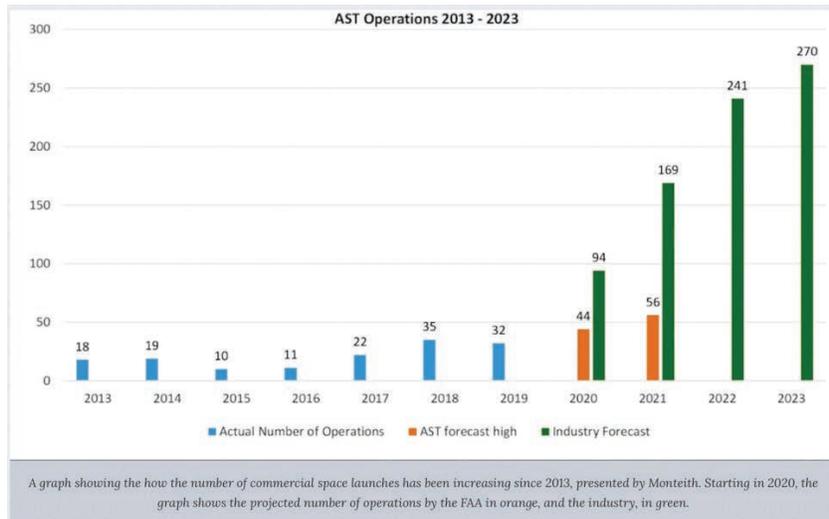
Note: Possible reentry locations lie anywhere along the blue and yellow ground track

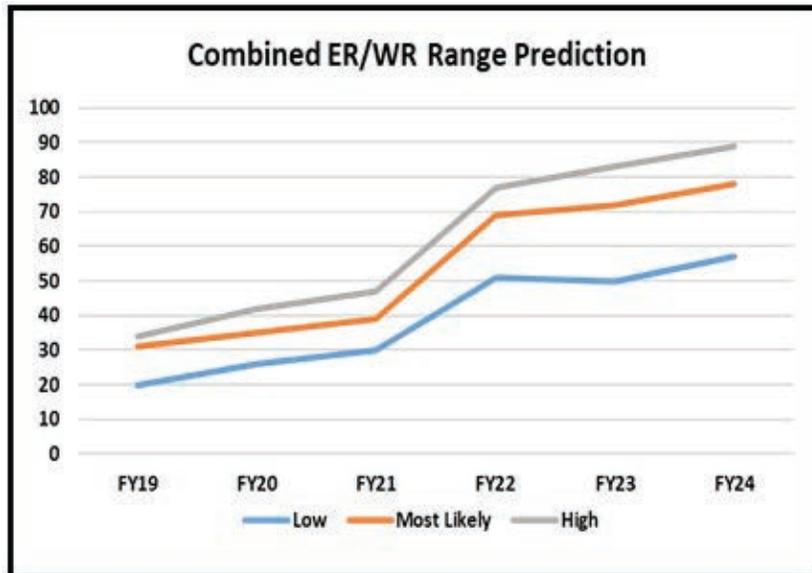
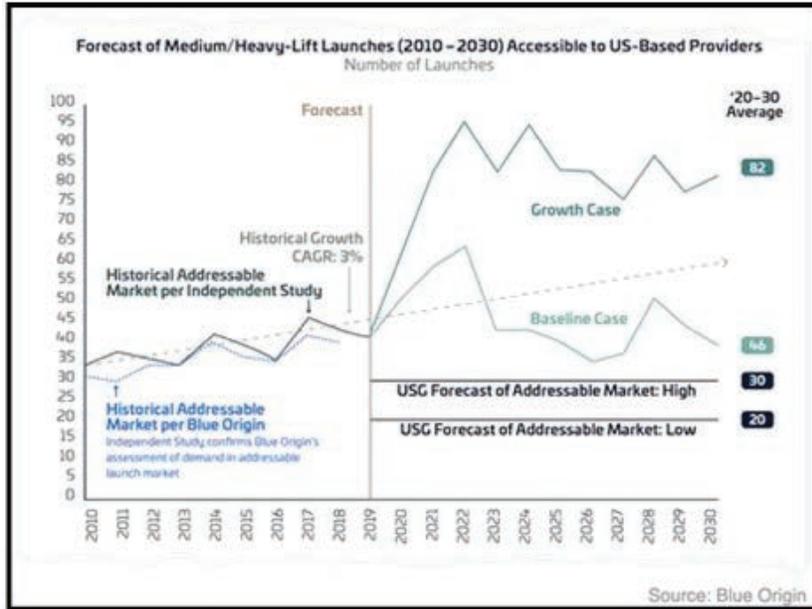
Long March 5-B HRAM Visualization 8 May (Post-Processed)

HRAM demonstration:



FAA Historical and Predicted Growth in AST Operations





Commercial Spaceports not co-located with Federal Ranges:

Spaceport	State
Pacific Spaceport Complex	Alaska
Colorado Air and Space Port	Colorado
Space Florida Launch & Landing—Wilson	Florida
Cecil Air and Space Port	Florida
Space Coast Regional Airport	Florida
Spaceport Camden (license pending)	Georgia
Space America	New Mexico
Oklahoma Space Industry Development Authority	Oklahoma
Houston Spaceport	Texas
Midland Spaceport	Texas

Definition of Organization Designated Authorizations:

The screenshot shows the FAA website's 'Delegated Organizations' page. The header includes the FAA logo and navigation links like 'FAA Home', 'Jobs', 'News', 'About FAA', 'A-Z Index', and 'FAA for You ...'. A search bar is also present. The main navigation menu lists categories: Aircraft, Airports, Air Traffic, Data & Research, Licenses & Certificates, Regulations & Policies, and Training & Testing. The page title is 'Delegated Organizations' and the breadcrumb trail is 'FAA Home > All Visitors > Aviation Industry > Designees & Delegations > Delegated Organizations'. The main content area explains that under Title 49 of the United States Code, the FAA may delegate to a qualified private person a matter related to issuing certificates, or related to the examination, testing, and inspection necessary to issue a certificate on behalf of the FAA Administrator as authorized by statute to issue under 49 USC 44702(a). It also states that the Organization Designation Authorization (ODA) program is the means by which the FAA grants designee authority to organizations or companies. The regulations addressing the ODA program are found in Title 14 of the Code of Federal Regulations (14 CFR) part 163, subpart D, sections 163.41 through 163.67. A sidebar on the left lists categories: Airmen, Aviation Industry (with sub-items: Airline Operators, Airport Operators, Designees & Delegations, About the Designee Program, Individual Designees, Aviation Medical Examiners (AME), Delegated Organizations, Become an ODA, Information for ODAs, Types of ODAs, Designee Management System (DMS), Find a Designee, Manufacturers), and Consultants & Contractors. A 'Top Tasks' box on the right lists: Find a Designee, Find an FAA Office, Find Forms for Designees, and Register for Designee Training.

51 U.S.C.: CHAPTER 509—COMMERCIAL SPACE LAUNCH ACTIVITIES**AMENDMENTS**

2010—Pub. L. 111–314, §4(d)(2), (3), Dec. 18, 2010, 124 Stat. 3440, transferred analysis for chapter 701 of Title 49, Transportation, and renumbered as analysis for chapter 509 of this title and renumbered items 70101 to 70105, 70105a, 70106 to 70109, 70109a, and 70110 to 70121 as 50901 to 50923, respectively.

2004—Pub. L. 108–492, §2(c)(26), Dec. 23, 2004, 118 Stat. 3982, added item 70105a.

2000—Pub. L. 106–405, §3(b), Nov. 1, 2000, 114 Stat. 1752, substituted “Office of Commercial Space Transportation” for “Authorization of appropriations” in item 70119.

Pub. L. 106–391, title III, §322(d), Oct. 30, 2000, 114 Stat. 1598, added item 70109a.

1998—Pub. L. 105–303, title I, §102(a)(1), Oct. 28, 1998, 112 Stat. 2846, substituted “launches, operations, and reentries” for “launches and operations” in item 70104, “launches, operation of launch sites and reentry sites, and reentries” for

“launches and operation of launch sites” in item 70108, inserted “or reentries” after “scheduled launches” in item 70109, and added items 70120 and 70121.

1994—Pub. L. 103-429, §6(78), Oct. 31, 1994, 108 Stat. 4388, made technical amendment to chapter heading.

§50901. *Findings and purposes*

(a) Findings.—Congress finds that—

- (1) the peaceful uses of outer space continue to be of great value and to offer benefits to all mankind;
- (2) private applications of space technology have achieved a significant level of commercial and economic activity and offer the potential for growth in the future, particularly in the United States;
- (3) new and innovative equipment and services are being sought, produced, and offered by entrepreneurs in telecommunications, information services, micro-gravity research, human space flight, and remote sensing technologies;
- (4) the private sector in the United States has the capability of developing and providing private launching, reentry, and associated services that would complement the launching, reentry, and associated capabilities of the United States Government;
- (5) the development of commercial launch vehicles, reentry vehicles, and associated services would enable the United States to retain its competitive position internationally, contributing to the national interest and economic well-being of the United States;
- (6) providing launch services and reentry services by the private sector is consistent with the national security and foreign policy interests of the United States and would be facilitated by stable, minimal, and appropriate regulatory guidelines that are fairly and expeditiously applied;
- (7) the United States should encourage private sector launches, reentries, and associated services and, only to the extent necessary, regulate those launches, reentries, and services to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States;
- (8) space transportation, including the establishment and operation of launch sites, reentry sites, and complementary facilities, the providing of launch services and reentry services, the establishment of support facilities, and the providing of support services, is an important element of the transportation system of the United States, and in connection with the commerce of the United States there is a need to develop a strong space transportation infrastructure with significant private sector involvement;
- (9) the participation of State governments in encouraging and facilitating private sector involvement in space-related activity, particularly through the establishment of a space transportation-related infrastructure, including launch sites, reentry sites, complementary facilities, and launch site and reentry site support facilities, is in the national interest and is of significant public benefit;
- (10) the goal of safely opening space to the American people and their private commercial, scientific, and cultural enterprises should guide Federal space investments, policies, and regulations;
- (11) private industry has begun to develop commercial launch vehicles capable of carrying human beings into space and greater private investment in these efforts will stimulate the Nation’s commercial space transportation industry as a whole;
- (12) space transportation is inherently risky, and the future of the commercial human space flight industry will depend on its ability to continually improve its safety performance;
- (13) a critical area of responsibility for the Department of Transportation is to regulate the operations and safety of the emerging commercial human space flight industry;
- (14) the public interest is served by creating a clear legal, regulatory, and safety regime for commercial human space flight; and
- (15) the regulatory standards governing human space flight must evolve as the industry matures so that regulations neither stifle technology development nor expose crew or space flight participants to avoidable risks as the public comes to expect greater safety for crew and space flight participants from the industry.

(b) Purposes.—The purposes of this chapter are—

- (1) to promote economic growth and entrepreneurial activity through use of the space environment for peaceful purposes;
- (2) to encourage the United States private sector to provide launch vehicles, reentry vehicles, and associated services by—
 - (A) simplifying and expediting the issuance and transfer of commercial licenses;
 - (B) facilitating and encouraging the use of Government-developed space technology; and
 - (C) promoting the continuous improvement of the safety of launch vehicles designed to carry humans, including through the issuance of regulations, to the extent permitted by this chapter;
- (3) to provide that the Secretary of Transportation is to oversee and coordinate the conduct of commercial launch and reentry operations, issue permits and commercial licenses and transfer commercial licenses authorizing those operations, and protect the public health and safety, safety of property, and national security and foreign policy interests of the United States; and
- (4) to facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities.

(Pub. L. 103–272, §1(e), July 5, 1994, 108 Stat. 1330, §70101 of title 49; Pub. L. 105–303, title I, §102(a)(2), Oct. 28, 1998, 112 Stat. 2846; Pub. L. 108–492, §2(a), Dec. 23, 2004, 118 Stat. 3974; renumbered §70101 then §50901 of title 51, Pub. L. 111–314, §4(d)(2), (3)(A), Dec. 18, 2010, 124 Stat. 3440.)

Historical and Revision Notes

<i>Revised Section</i>	<i>Source (U.S. Code)</i>	<i>Source (Statutes at Large)</i>
70101(a)	49 App.: 2601	Oct. 30, 1984, Pub. L. 98–575, §§2, 3, 98 Stat. 3055; Nov. 16, 1990, Pub. L. 101–611, §117(c), (d), 104 Stat. 3202.
70101(b)	49 App.: 2602.	

In subsection (a), before clause (1), the words “and declares” are omitted as surplus.

In subsection (b), before clause (1), the word “therefore” is omitted as surplus.

AMENDMENTS

2010—Pub. L. 111–314 successively renumbered section 70101 of title 49 and section 70101 of this title as this section.

2004—Subsec. (a)(3). Pub. L. 108–492, §2(a)(1), inserted “human space flight,” after “microgravity research.”

Subsec. (a)(4). Pub. L. 108–492, §2(a)(2), struck out “satellite” after “providing private” and substituted “capabilities of” for “services now available from”.

Subsec. (a)(10) to (15). Pub. L. 108–492, §2(a)(3)–(5), added pars. (10) to (15).

Subsec. (b)(2)(C). Pub. L. 108–492, §2(a)(6), added subpar. (C).

Subsec. (b)(3). Pub. L. 108–492, §2(a)(7), substituted “issue permits and commercial licenses and transfer” for “issue and transfer”.

1998—Subsec. (a)(3). Pub. L. 105–303, §102(a)(2)(A), inserted “microgravity research,” after “information services.”

Subsec. (a)(4). Pub. L. 105–303, §102(a)(2)(B), inserted “, reentry,” after “launching” in two places.

Subsec. (a)(5). Pub. L. 105–303, §102(a)(2)(C), inserted “, reentry vehicles,” after “launch vehicles”.

Subsec. (a)(6). Pub. L. 105–303, §102(a)(2)(D), inserted “and reentry services” after “launch services”.

Subsec. (a)(7). Pub. L. 105–303, §102(a)(2)(E), inserted “, reentries,” after “launches” in two places.

Subsec. (a)(8). Pub. L. 105–303, §102(a)(2)(F), (G), inserted “, reentry sites,” after “launch sites” and “and reentry services” after “launch services”.

Subsec. (a)(9). Pub. L. 105-303, §102(a)(2)(H), (I), inserted “reentry sites,” after “launch sites,” and “and reentry site” after “launch site”.

Subsec. (b)(2). Pub. L. 105-303, §102(a)(2)(J), inserted “, reentry vehicles,” after “launch vehicles” in introductory provisions.

Subsec. (b)(2)(A). Pub. L. 105-303, §102(a)(2)(K), struck out “launch” before “licenses”.

Subsec. (b)(3). Pub. L. 105-303, §102(a)(2)(L), (M), inserted “and reentry” after “conduct of commercial launch” and struck out “launch” before “licenses”.

Subsec. (b)(4). Pub. L. 105-303, §102(a)(2)(N), inserted “and development of reentry sites,” after “launch-site support facilities,”.

FINDINGS

Pub. L. 106-405, §2, Nov. 1, 2000, 114 Stat. 1751, provided that: “The Congress finds that—

- “(1) a robust United States space transportation industry is vital to the Nation’s economic well-being and national security;
- “(2) enactment of a 5-year extension of the excess third party claims payment provision of [former] chapter 701 of title 49, United States Code [now 51 U.S.C. 50901 et seq.] (Commercial Space Launch Activities), will have a beneficial impact on the international competitiveness of the United States space transportation industry;
- “(3) space transportation may evolve into airplane-style operations;
- “(4) during the next 3 years the Federal Government and the private sector should analyze the liability risk-sharing regime to determine its appropriateness and effectiveness, and, if needed, develop and propose a new regime to Congress at least 2 years prior to the expiration of the extension contained in this Act [see Tables for classification];
- “(5) the areas of responsibility of the Office of the Associate Administrator for Commercial Space Transportation have significantly increased as a result of—
 - “(A) the rapidly expanding commercial space transportation industry and associated government licensing requirements;
 - “(B) regulatory activity as a result of the emerging commercial reusable launch vehicle industry; and
 - “(C) the increased regulatory activity associated with commercial operation of launch and reentry sites; and
- “(6) the Office of the Associate Administrator for Commercial Space Transportation should continue to limit its promotional activities to those which support its regulatory mission.”

APPENDIX

QUESTIONS FROM HON. EDDIE BERNICE JOHNSON TO WAYNE R. MONTEITH, ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION

Question 1. Mr. Monteith, this Subcommittee's role focuses on managing the safe integration of commercial spaceflight through the national airspace system. Ms. Krause's written statement notes, "full and efficient integration of all users of the National Airspace System is years away and will require continued work and focus." How are you working with the FAA on this integration and with which element of FAA are you coordinating?

ANSWER. We have worked with the FAA's William J. Hughes Technical Center in Atlantic City, New Jersey to build the agency's first dedicated commercial space integration lab for developing and prototyping technologies that will be leveraged towards enhancing commercial space operation awareness to better manage the NAS. Additionally, AST continues its work with the FAA's Air Traffic Organization on the Space Data Integrator technology. This safety-based technology, which has automated the previous manual processes, will enable the FAA to monitor a space mission's progress as it flies through the airspace. When deployed, this technology will enable the FAA to better manage the airspace that must be closed to other users and more quickly implement and release airspace restrictions as a mission progresses.

In addition to the initiatives above, the FAA's Air Traffic Organization is also working on two techniques to reduce the impact of commercial space launches on aviation.

- Time Based Launch Procedures (TBLP) have been implemented for launch and reentry operations at Kennedy Space Center/Cape Canaveral Air Force Station (KSC/CCAFS). TBLP utilizes existing Traffic Flow Management procedures and processes to more efficiently manage operations at KSC/CCAFS. Where appropriate, TBLP will be expanded to other spaceports and federal ranges this year.
- Dynamic Launch and Reentry Windows (DLRW) procedures have been developed for KSC/CCAFS. DLRW utilizes mission triggers in launch and reentry operator mission processes to gain further efficiencies in addition to those afforded by TBLP. Where appropriate, DLRW will be expanded to other spaceports and federal ranges this year.

Question 2. Mr. Monteith, Ms. Krause's written statement refers to a 2021 memorandum of agreement with AST and NASA regarding public and human spaceflight safety for commercial space transportation and also accident investigations. I'd like to request a copy of this Memorandum be sent to the Committee on Science, Space, and Technology to support our oversight and policy work on AST, commercial spaceflight, and commercial spaceflight accident investigation.

ANSWER. We have enclosed a copy of the memo with the responses to these QFRs.

Question 3. Mr. Monteith, there has been mention by a few of the witnesses here today about the necessity of "the Federal Aviation Administration growing its workforce" to meet the rapidly expanding industry needs, and I am wondering if, in conjunction with that need, there has been discussion within the FAA about ensuring that minorities will be included in this future labor force? Do you now or will you reach out to HBCU's, particularly those that specialize in the STEM fields, as partners?

ANSWER. Yes, there absolutely has been not only discussion, but action at the FAA to reach out to HBCUs. The FAA fully supports Presidential Executive Order #13779—The White House Initiative to Promote Excellence and Innovation at Historically Black Colleges and Universities. The FAA HBCU Initiative Team has supported White House HBCU Week for several years, last year hosting a virtual career fair booth, and this year we are hosting a workshop on opportunities for

HBCUs at the FAA on September 8, 2021. And we plan to participate in the Initiative's Career Fair on September 9, 2021.

The FAA HBCU Initiative Team is an agency-wide effort that supports the workforce development needs of the FAA by attracting and retaining a diverse and skilled workforce to proactively address transformative technological challenges, in not just aviation and commercial space transportation, but also drones, cybersecurity, and data evaluation. In addition, the team is working to increase HBCU participation in grants, research and college initiative programs in collaboration with the FAA.

We also have a robust corporate recruitment plan, which includes specific outreach to eleven HBCUs based on STEM, Aviation, and Aerospace program offerings. These efforts include: participation in career fairs; building relationships with academic departments and Career Centers; and outreach to diverse student organizations on campus.

Since this past spring, we have focused efforts at the following HBCUs:

1. Bowie State University
2. Delaware State University
3. Florida Memorial University
4. Johnson C. Smith University (*Added mid-Spring; will be included in Fall*)
5. Hampton University
6. Howard University
7. Morgan State University
8. Norfolk State University
9. Tennessee State University
10. Texas Southern University
11. Tuskegee University

In addition, the FAA places a very high priority not only on inspiring the aerospace workforce of the future, but on ensuring that our workforce is one that is diverse and representative of our nation's population. One of the four main goals of the FAA's Science Technology Engineering and Math Aviation and Space Education (STEM AVSED) corporate strategy is to ensure that all students, regardless of race, gender, geographic location, physical disabilities, and financial background have access to pathways to aerospace careers. As an example, our Adopt-a-School program—that targets schools that have majority underserved and/or underrepresented populations—will kick off this school year and will introduce 4th grade students to various aerospace careers and concepts, including commercial space.

Lastly, the FAA is looking forward receiving the report from the Youth Access to American Jobs in Aviation Task Force, which will include recommendations on how to ensure a more diverse aerospace workforce moving into the future. We are certainly doing our part to participate in this program, and I fully support its work.

MEMO REFERENCED IN RESPONSE TO QUESTION 2:

MEMORANDUM OF UNDERSTANDING BETWEEN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND THE FEDERAL AVIATION ADMINISTRATION REGARDING ACHIEVEMENT OF MUTUAL GOALS IN COMMERCIAL SPACE ACTIVITIES

The National Aeronautics and Space Administration (“NASA”) and the Federal Aviation Administration (“FAA”), through this Memorandum of Understanding (“MOU”), affirm their intent to continue their longstanding partnership on mutually beneficial commercial space activities in furtherance of U.S. national space policy and commercial space transportation-related interests. In this MOU, NASA and the FAA may be individually referred to as a “Party” and collectively referred to as the “Parties.”

I. Background

NASA and the FAA have enjoyed a successful and longstanding relationship in support of both Parties' efforts to bring commercial crew and cargo activities to fruition as well as bolstering the pace and scope of American aerospace innovations. This cooperation was highlighted by the successful Commercial Crew Program's demonstration and operational missions to the International Space Station, which greatly benefitted from several years of effective cooperation between NASA and the FAA. The close partnership between NASA and the FAA has afforded the Parties the opportunity to further other activities in their respective mission areas based on experiences and lessons learned through this partnership.

NASA and the FAA also have a strong existing relationship on commercial sub-orbital spaceflight whereby NASA's Flight Opportunities program relies on FAA li-

censing and regulations when fulfilling its mission of facilitating rapid demonstration of promising technologies for space exploration, discovery, and the expansion of space commerce through suborbital testing with industry flight providers. NASA's Flight Opportunities program also has provided test flights for FAA-sponsored safety enabling technologies, in particular through the FAA's Center of Excellence for Commercial Space Transportation. Recently, NASA and the FAA Office of Commercial Space Transportation collaborated on developing the framework for flying NASA-sponsored spaceflight participants on commercial suborbital flights, allowing researchers from industry and academia to propose to fly with their NASA-sponsored payloads for the first time. NASA is also collaborating with the FAA on commercial suborbital spaceflight activities through the Commercial Crew Program's Suborbital Crew (SubC) efforts to extend suborbital space transportation capabilities for NASA astronauts and other NASA personnel. NASA seeks to enter into public-private partnerships to improve airspace, passenger, and crew safety while enhancing the capabilities of commercial suborbital point-to-point spacecraft.

NASA and the FAA have complementary and interdependent interests in (1) creating a robust commercial space industry to achieve safe, reliable, and cost-effective access to space, and (2) enhancing the competitiveness, safety, and affordability of American aerospace capabilities including next-generation capabilities such as suborbital spaceflight systems. Continuing this partnership is critical to achieving the goals and objectives of multiple U.S. space policies, including the 2020 National Space Policy and Space Policy Directives 1, 2, and 3.

II. Scope

This MOU is intended to support commercial space activities related to the transport of government and non-government passengers, cargo, and payloads for both orbital and suborbital missions in a safe, cost-effective manner that avoids conflicting requirements and multiple sets of standards. The MOU is also intended to advance U.S. Government and commercial interests in developing a prosperous American commercial space industry. In support of these goals, the Parties intend to exchange knowledge and best practices and may pursue collaborative commercial aerospace-related activities in a variety of areas consistent with each Party's mission and applicable law.

Areas in which the Parties seek to work together to continue their successful cooperation and pursue new collaborations include but are not limited to:

- Launch and Reentry Industry Framework
 - Provide a stable framework between NASA requirements and FAA regulations for the U.S. space launch industry, including human spaceflight, that is transparent, avoids conflicting requirements and multiple sets of standards, and encourages growth and innovation.
 - Increase transparency during the license review process by developing applicant guidance in the form of an Advisory Circular and interagency standard operating procedures for when agencies may seek additional information.
 - Develop and foster best practices for spacecraft conjunction assessment and on-orbit operations, including large constellations.
 - Advance the interests of those supporting private astronaut missions by collaborating to ensure consistency between NASA contract or agreement requirements and FAA statutes and regulations.
 - Advance the interests of U.S. commercial launch operators responsible for transporting domestic and international partner astronauts on suborbital crewed missions, as well as missions to low-Earth orbit ("LEO," including to the International Space Station, and future private sector free-flying platforms).
- Medical
 - Through their respective Chief Health and Medical Officer and Federal Air Surgeon or their designees, seek to share de-identified spaceflight clinical medical data, information, and knowledge on the biomedical (physiological and pathological) effects of orbital and suborbital spaceflight (long and short-duration) among occupants of space vehicles and space habitats, including post-flight medical aspects.
- Safety
 - Advance both public safety and human spaceflight safety.
 - Coordinate on lessons learned from mishap investigations.
 - Coordinate on an approach for sharing safety data with the public to enhance understanding of the known risks of space.

- Suborbital Spaceflight
 - NASA seeks to work with and rely on FAA regulation and licensing of commercial suborbital spaceflight transportation providers to strategically invest in and facilitate rapid demonstration of promising space technologies including point-to-point transportation, test and qualify spaceflight hardware, and conduct human-tended microgravity research, astronaut training, and human spaceflight activities.
 - Seek out areas for collaborative research opportunities, jointly and with academia or industry when practical, to advance technologies and scientific knowledge that will benefit the commercial space transportation industry.
 - NASA and the FAA seek to advance the interests of a commercial suborbital point-to-point pilot program with designated spaceports, airspace design, sequencing, launch and landing windows, etc.
- Individual Preparation for Human Spaceflight
 - Collaborate on best practices for familiarization of participants with spaceflight safety factors (individual, operational, and environmental), individual evaluation/selection techniques, and personal qualifications for orbital and suborbital flights.

III. Collaboration on Specific Activities

The roles and responsibilities of each Party for specific activities will be documented in non-binding Joint Program Management Plans at the program level if needed. Should both Parties agree to enter into binding obligations in connection with the activities described in this MOU, the Parties will negotiate and enter into separate agreements, fully independent of this MOU, and as permitted by and in accordance with law and the respective Parties' policies and processes.

IV. Authority

The FAA is entering into this MOU under the authority of 49 U.S.C. 106(l) (6) and 106(m).

V. Points of Contact

The following personnel are designated as the Points of Contact between the Parties in the performance of this MOU:

Technical Points of Contact

NASA

Philip McAlister
 Director, Commercial Spaceflight Development Division
 Human Exploration and Operations Mission Directorate
 [Email and phone number omitted from published record]

Christopher Baker
 Small Spacecraft Technology and Flight Opportunities Program Executive
 Space Technology Mission Directorate
 [Email and phone number omitted from published record]

FAA

Randy Repcheck
 (A) Exec Dir, Office of Operational Safety
 Office of Commercial Space Transportation, FAA
 [Email and phone number omitted from published record]

Administrative Points of Contact

NASA

Jennifer Troxell
 Senior Interagency Programs Specialist
 Office of International and Interagency Relations
 [Email and phone number omitted from published record]

FAA

Pam Underwood
 Director, Office of Spaceports
 FAA Office of Commercial Space Transportation
 [Email and phone number omitted from published record]

VI. Miscellaneous

- A. NASA and FAA agree that the information and data exchanged in furtherance of the activities under this MOU will be exchanged without use and disclosure

restrictions, unless required by law in accordance with restrictive markings on the information or data. Each party shall take appropriate measures to protect proprietary, privileged or otherwise confidential information obtained as a result of its activities under this MOU.

- B. This MOU is strictly for the management and planning purposes of each of the Parties.
- C. This MOU does not support an obligation of funds, nor does it constitute a binding commitment upon either Party or create any legal rights or obligations for either Party.
- D. Nothing in this MOU shall be interpreted as limiting, superseding, or otherwise affecting a Party from conducting normal operations or making decisions in carrying out its mission and duties.
- E. This MOU does not limit or restrict the Parties from participating in similar activities or arrangements with other entities.
- F. Each Party shall be responsible for any and all expenses incurred by that Party relating to this MOU, and neither Party will be responsible for any expense incurred by the other Party unless specifically agreed to in writing, separate from and independent of this MOU.
- G. Administration of this MOU and coordination of subsequent NASA-FAA agreements for activities identified in section II of this MOU will be the responsibility of the offices identified as the "Administrative Points of Contact" in section V of this MOU.
- H. Either Party may unilaterally terminate this MOU upon ninety (90) calendar days written notice to the other Party.
- I. This MOU becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until either (a) a Party decides to terminate its participation according to Section VI (H) of this MOU, or (b) ten (10) calendar years from the Effective Date, whichever comes first.
- J. Any modification to this MOU will be executed in writing and signed by an authorized representative of NASA and the FAA.

VII. Signatures

The respective authorized officials of each organization hereby execute this MOU on the date set forth below.

JAMES BRIDENSTINE,
Administrator, National Aeronautics and Space Administration.
Date: January 4, 2021.

STEVE DICKSON,
Administrator, Federal Aviation Administration.
Date: January 4, 2021.

QUESTIONS FROM HON. NIKEMA WILLIAMS TO WAYNE R. MONTEITH, ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION

Question 1. Everything I do in Congress is to give the people of Georgia's Fifth District a seat at the table. As we discuss the development of commercial space transportation, we need to center the needs of our constituents in the conversation.

To start, I'd like to get more information on how more frequent commercial space transportation can be harmonized with the transition to a carbon-neutral economy.

Mr. Monteith, in what ways can the Federal Aviation Administration provide leadership toward use of sustainable fuels in commercial space transportation, and what environmental significance would this have as commercial space transportation grows?

ANSWER. The FAA can provide leadership toward the use of sustainable fuels by continuing to make informed decisions about the potential environmental effects of: (1) issuing vehicle and launch site operator licenses and permits, and (2) greenhouse gas emissions and air quality. To that end, the FAA is supportive of this Administration's efforts to provide guidance on assessing greenhouse gas emissions and climate change effects in the National Environmental Policy Act process.

The FAA also provides leadership in the development and use of sustainable aviation fuels (SAF) that are replacements for kerosene jet fuels. To the extent that commercial space providers are utilizing kerosene as their energy source, FAA's ongoing efforts could be leveraged to support sustainable fuels in commercial space. FAA initiatives on SAF focus on:

- *Safety testing and evaluation of candidate SAFs* in partnership with industry to enable addition to the ASTM International jet fuel specification which allows for commercial aviation use of the fuel in turbine engines.

- *Analysis of environmental, economic and supply potential* through the FAA's ASCENT Center of Excellence University research consortium to understand the opportunities to reduce costs and enable expansion of supply.
- *Coordination among government, academic and aviation industry stakeholders* to address challenges and engage with the emerging alternative jet fuels industry through FAA participation on a federal SAF interagency working group and through FAA sponsorship of the Commercial Aviation Alternative Fuels Initiative.

The FAA is committed to fulfilling directives from the President's recent Executive Orders addressing climate change and environmental justice.

Question 2. You also mentioned in your testimony that the Federal Aviation Administration has a key role to play in ensuring equal access to the airspace.

Can you tell us more about the Federal Aviation Administration's goals to ensure the needs of users in the national airspace system are safely and effectively balanced with those of the space industry? How can achieving efficiency in balancing these needs serve everyday people and their needs from the transportation system in general?

ANSWER. The FAA strives to reach the next level of safety and efficiency and to demonstrate global leadership in how we safely integrate new users and technologies into our aviation system. We are currently working to integrate several new and innovative users into our National Airspace System (NAS), commercial space, unmanned aircraft systems, and advanced air mobility.

Integrating commercial space into the NAS safely and effectively is how we can best ensure that the needs of all users of the NAS are met. Commercial space operations are currently treated as "special cases" in which air traffic controllers block off sections of airspace for extended periods of time for a single launch. Although this process is currently manageable, it is unsustainable in the long run given the expected growth in commercial space launches.

We are actively working on solutions to address how commercial space will grow within the NAS alongside commercial, general aviation, and other new entrants so that the flying public is inconvenienced as little as possible, while also ensuring that the commercial space industry and its jobs and missions do not flee overseas.

AST continues its work with the FAA's Air Traffic Organization on the Space Data Integrator technology. This safety-based technology, which has automated the previous manual processes, will enable the FAA to monitor a space mission's progress as it flies through the airspace. When deployed, this technology will enable the FAA to better manage the airspace that must be closed to other users and more quickly implement and release airspace restrictions as a mission progresses.

In addition, the FAA's Air Traffic Organization is also working on two techniques to reduce the impact of commercial space launches on aviation.

- Time Based Launch Procedures (TBLP) have been implemented for launch and reentry operations at Kennedy Space Center/Cape Canaveral Air Force Station (KSC/CCAFS). TBLP utilizes existing Traffic Flow Management procedures and processes to more efficiently manage operations at KSC/CCAFS. Where appropriate, TBLP will be expanded to other spaceports and federal ranges this year.
- Dynamic Launch and Reentry Windows (DLRW) procedures have been developed for KSC/CCAFS. DLRW utilizes mission triggers in launch and reentry operator mission processes to gain further efficiencies in addition to those afforded by TBLP. Where appropriate, DLRW will be expanded to other spaceports and federal ranges this year.

At the FAA, we recognize that our role is not just limited to the safety of the airspace—but to ensure equal access to it as well. We are fully engaged in balancing the needs of all airspace users—including traditional manned aircraft, drones, commercial space transportation, and others.

QUESTIONS FROM HON. GARRET GRAVES TO WAYNE R. MONTEITH, ASSOCIATE ADMINISTRATOR FOR COMMERCIAL SPACE TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION

Question 1. Gen. Monteith, a much-touted feature of the new launch rules are the incremental review processes that allow applicants to advance new concepts, critically important for companies advancing the state of the art for space launch. How is implementation of this incremental review going? Are there some good examples to point to of this is opening new doors to innovation?

ANSWER. Incremental review allows FAA to make determinations earlier in the licensing process, benefiting the industry by reducing regulatory uncertainty and

providing increased transparency with incremental approvals ahead of a determination on the license in its entirety.

The FAA accepted its first incremental review approach on June 3, 2021. FAA is working with several other applicants who have expressed interest in submitting their application using incremental review. The new streamlined launch and reentry rules allow an applicant to submit an application for a safety review in modules using an incremental approach approved by the FAA. An applicant must have its incremental review approach approved by the FAA so that the FAA can ensure that the modules can be reviewed independently and in a workable order under an agreed time frame.

FAA designed the new launch and reentry rules to allow for innovation in several ways. In addition to incremental review, performance-based rules give industry greater flexibility to develop new means of compliance that meet their objectives while maintaining public safety. The new rules offer alternatives to flight abort and flight safety analysis requirements based on demonstrated reliability, use of equivalent level of safety for the measurement of a high consequence event, and by allowing application process alternatives as agreed to by the FAA.

Question 2. Gen. Monteith, the flexible approach taken by writing performance-based new rules creates a lot of room for applicants to bring forward innovative plans for safe launch to the FAA to evaluate and render decision. What is the status of the advisory circulars that help applicants understand what might be approved? How can stakeholders weigh in on the content of these advisory circulars, both before and after their publication?

ANSWER. The advisory circulars (AC) are being written and coordinated as expeditiously as possible. Two ACs have been published, with eight more projected to be published and available for stakeholder use by 30 September 2021.

Stakeholders have several means to weigh in on the AC prior to publication. The Common Standards Working Group (FAA, NASA, and USSF) review and provide comments on all ACs prior to final review and publication of each AC. All stakeholders can view the list of published and planned ACs on the FAA's external website (https://www.faa.gov/space/streamlined_licensing_process/media/Part_450_Means_of_Compliance_Table_with_dates.pdf) and provide input to the FAA on any of the ACs—either prepublication or after they are published. After publication, the FAA seeks public comment on each document and will issue an updated version if warranted based on comments received. Each guidance document also contains a feedback form with instructions on how to provide feedback at any time. At the end of every published AC is this statement: “If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) emailing this form to ASTApplications@faa.gov, or (2) faxing it to (202) 267–5450.” We review and adjudicate all recommendations and will promptly issue a revision to incorporate improvements, additions, or to correct errors.

QUESTIONS FROM HON. EDDIE BERNICE JOHNSON TO HEATHER KRAUSE, DIRECTOR,
PHYSICAL INFRASTRUCTURE, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Question 1. Ms. Krause, this Subcommittee's role focuses on managing the safe integration of commercial spaceflight through the national airspace system. Ms. Krause, in your written statement you note, “full and efficient integration of all users of the National Airspace System is years away and will require continued work and focus.” How are you working with the FAA on this integration and with which element of FAA are you coordinating?

ANSWER. Our 2019 report¹—issued in response to the most recent request we received to review these and other issues—identified actions FAA was taking to increase efficiency of how launches are integrated into the National Airspace System. In doing this work, we found that various offices within FAA were supporting efforts that included, but were not limited to, developing new technologies; assessing potential changes to policies, procedures, and regulations; and coordinating with aviation- and space-industry stakeholders. For example, FAA's Air Traffic Organization, Office of Commercial Space Transportation, Office of Airports, and Office of NextGen played a part in identifying and developing steps—outlined in two internal FAA documents—to help guide the development and implementation of its actions related to integrating space launch and reentry operations. As part of our 2019 report, we

¹ *Commercial Space Transportation: Improvements to FAA's Workforce Planning Needed to Prepare for the Industry's Anticipated Growth*, GAO-19-437 (Washington, D.C.: May 23, 2019).

did not make any recommendations on FAA's ongoing actions related to airspace integration.

Since that time, we obtained some updated information on FAA's progress in making operational changes to increase efficiency. For example, FAA reported that on June 30, 2021, it activated the use of its Space Data Integrator (SDI) prototype that provides real-time situational awareness of a launch vehicle, including position, altitude, speed, and if the vehicle deviates from its expected launch path. FAA reported that SDI allows FAA to safely reopen the airspace more quickly and reduce the number of aircraft and other airspace users affected by a launch or reentry. Although these developments are promising, given the complexity of monitoring space launches through the National Airspace System, it will be important for FAA to maintain vigilant oversight of its SDI efforts to ensure the program's benefits are realized in a timely manner.

Question 2. Ms. Krause, regarding launch licenses, your written testimony stated that "Industry growth may present challenges to AST's approach to overseeing compliance and enforcement." What, in your view, are the safety implications of these challenges?

ANSWER. AST's role as a regulator of commercial space launch providers is fundamental to the continued safe growth of the industry. With the anticipated continued growth and development of new technologies and types of launches and supporting infrastructure, it is vital that AST ensure that the size, composition, and skills of its workforce are aligned with its projected workload, including the amount and type of work. AST has made strides in more strategically aligning its workforce with evolving industry demands. For example, in response to one of the four recommendations we made in 2019, AST assessed its workforce to identify skills and competencies that are currently needed among its workforce as well as specific competency areas that may be needed in the future and reported that it developed strategies to address any workforce skills gaps.

It will be important for AST to follow through on its other planned efforts in response to our recommendations to ensure it can oversee the safe growth of the industry. For example, AST should continue:

1. developing workload metrics that encompass the whole office and would allow AST to determine an appropriate workforce size and composition; and
2. working with FAA's Office of Labor Analysis to extend AST's workload projections to a 5-year time period and to include an approach to address uncertainty.

AST's approach to overseeing compliance and enforcement mainly consists of safety inspections before, during, and after FAA-regulated operations that can impact public safety and the safety of property. In light of the growing number and diversification of launch and reentry operations and locations, AST's approach to overseeing compliance and enforcement may warrant review. AST announced in July 2021, that it is increasing its safety inspection staff and recently opened a field office in Houston, Texas, to, according to the agency, allow it to more effectively and efficiently monitor the on-going testing programs and planned space tourism operations in Texas and New Mexico. We plan to begin a review of FAA's safety oversight of commercial space activities at the request of this committee later this year.

QUESTIONS FROM HON. GARRET GRAVES TO SALVATORE T. "TORY" BRUNO, PRESIDENT AND CHIEF EXECUTIVE OFFICER, UNITED LAUNCH ALLIANCE, LLC

Question 1. Can you please describe how a launch window is determined? Are there instances where reducing the launch window to accommodate air traffic is possible? What are the downsides to reducing a launch window?

ANSWER. Launch windows are determined directly by the orbital destination of the spacecraft, not by the convenience of the launch provider. Any given orbital destination dictates the targeted time of day of the launch. This is a precise moment. The launch window, or span of time before and after this instantaneous moment, is determined by the physics of the destination orbit and the performance of the rocket. The most common duration of a launch window is between 30 and 90 minutes. This span of time is essential in order to reliably launch on any given day. Unlike an aircraft, a Space Launch Vehicle cannot fly around or over thunderstorms. It cannot lift off if there is lightning within several miles of the pad or cumulus clouds overhead because of the catastrophic risk of a lightning strike to a rocket carrying upwards of a million pounds of highly explosive propellants. Most launches occur from the Cape Canaveral Space Force Station, a location infamous for its inconsistent weather. Additionally, a SLV is a very complex, twenty to thirty story tall machine that must be loaded with extremely cold cryogenic propellants,

who's thermodynamic state is precisely controlled by complex ground systems. Given the delicate and complicated nature of these processes, along with the critical nature of often unique payloads, it is not uncommon for a countdown to be paused while an unexpected issue is safely worked through. When a countdown is recycled due to weather or a technical issue, it typically takes 15 to 20 minutes to recycle the count after resolution or clearing of the skies. A significant curtailment of the available launch window would leave a launch without an adequate opportunity to work around weather or technical issues and result in frequent scrubs. This will lead to multiple days of air traffic disruptions and millions of dollars of expense as launch crews extend and propellants are lost.

Question 2. In your testimony, you talk about various forms of reentry. Can you please describe the differences between controlled and uncontrolled reentry of satellites or rocket bodies?

ANSWER. Because the reentry into the Earth's atmosphere of objects that do not fully burn up in the process poses risks to human populations, critical infrastructure, and the natural environment, it is important to design, engineer, test, and operate those objects, so as to ensure that their reentry is controlled to eliminate or minimize those risks.

In a controlled reentry, a spacecraft or rocket stage is still operable and will use thrust to position itself in a way that its reentry is relatively planned and predictable. In most cases, these reentries will take place over remote ocean areas. Saving fuel to control a reentry incurs a cost on the operator, but it is a price worth paying to protect the orbital environment and ensure our use of space.

Uncontrolled reentries take place because an operator has lost control of their spacecraft or rocket stage. Usually this is due to a lack of fuel or some type of malfunction. In this scenario, the spacecraft or rocket stage is at the mercy of gravity and could reenter over a populated area, and it is very difficult to predict where the reentry will occur until minutes ahead of time. We saw this recently with the reentry of a Chinese Long March 5B. Uncontrolled reentries propose a low but very real risk to people on the ground and users of the National Airspace System. In some cases, uncontrolled reentries can even pose risks to astronauts and the International Space Station (ISS), particularly when we are dealing with low earth orbit satellites positioned at a higher altitude than the ISS.

QUESTIONS FROM HON. EDDIE BERNICE JOHNSON TO FRANK DiBELLO, PRESIDENT
AND CHIEF EXECUTIVE OFFICER, SPACE FLORIDA

Question 1. Mr. DiBello, in your written testimony you "call on Congress to authorize and fund an infrastructure program aimed at enabling America's space transportation leadership." What do you think the necessary funding numbers should be, and do you believe there is congressional or political receptivity to making this type of investment and finding a source to pay for it?

ANSWER. Thank you for your question, Congresswoman Johnson. To remain competitive in an increasingly contested global space market in which China and others have become increasingly emboldened, the US must invest in our space transportation infrastructure. Tomorrow, the House Space Subcommittee is holding a hearing entitled, "Enabling Mission Success From the Ground Up: Addressing NASA's Urgent Infrastructure Needs" (emphasis added). Beyond federal assets, we know that the availability of state, local, and privately-operated launch and reentry sites across our nation make the US space transportation system stronger and better able to adapt to industry innovation and changing global markets, and offer the US government new opportunities for meeting its space lift needs.

In the State of Florida, space has long been designated as a mode of transportation, which has allowed our organization to partner with private capital markets to invest in infrastructure improvements at the Cape and elsewhere around the state. However, the network of commercial and privately-operated spaceports extends across our country, beyond Florida to Texas, California, New Mexico, Alaska, Oklahoma, and Colorado. Our engagement with our colleagues in this emerging U.S. spaceport system convinces us there is broad political receptivity to making investments in these non-federal assets that strengthen our nation's leadership in the exploration and practical use of space.

The aviation industry began with significant and intentional government support before the marketplace was mature enough to generate revenue to support airport improvements. Space Florida is aware that this is a sensitive topic for some, and we feel strongly that all stakeholders should be consulted to find the best way forward. Whatever the solution decided upon by stakeholders, the importance of timely investment in space infrastructure cannot be overstated.

QUESTIONS FROM HON. EDDIE BERNICE JOHNSON TO CAPTAIN JOSEPH G. DEPETE,
PRESIDENT, AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

Question 1. Captain Joseph G. DePete, your testimony details serious concerns about safety, not only for pilots but for the millions of people in our nation and throughout the world. You mention, among other concerns, examples of various pieces of out of control, falling debris, some of which weigh tens of thousands of pounds and are moving at very, very fast speeds. So, I am wondering, in your communications with the FAA, private sector industry leaders, and in your recent letter to the International Civil Aviation Organization's Secretary General, Dr. Fang Liu listing your concerns, what kinds of responses have you received? Do the stakeholders seem to be taking safety concerns seriously and do you believe they have plans to confront these very serious safety issues in their future work?

ANSWER. Thank you for your follow-up questions regarding our testimony on the Subcommittee on Aviation hearing, "Starships and Stripes Forever—An Examination of the FAA's Role in the Future of Spaceflight". I am writing this letter in response to those questions.

Communications with the FAA, Aviation Stakeholders and the Commercial Space Industry.

ALPA regularly attends several FAA and private sector industry venues such as the Commercial Space Transportation Advisory Committee (COMSTAC). This committee, established under the authority of the Department of Transportation (DOT), provides information, advice, and recommendations to the Secretary of Transportation through the Federal Aviation Administration. ALPA attends the COMSTAC as a member of the public.

There does not appear to be adequate representation or a broad official voice for the traditional aviation industry on the COMSTAC, with the exception of Airlines for America (A4A). The COMSTAC primarily focuses on the regulatory requirements to gain access to the National Airspace System (NAS) as well as the system requirements for commercial space vehicles.

ALPA also participates on FAA Safety Risk Management (SRM) Panels for operational issues impacting the NAS, including commercial space launch. Previously, ALPA and industry stakeholders held positions as voting panel members on SRM panels. The FAA's decision several years ago to exclude external stakeholders as voting panel members has reduced the voice and opinions of stakeholders external to the FAA significantly. Without an active vote, traditional aviation stakeholders' recommendations are heard but often discounted by the voting panel members. Our concerns have been echoed by other aviation stakeholders, both in the detail of how FAA manages launch and recovery operations, as well as the higher level concerns about participation on Safety Panels.

FAA and commercial space committees and workgroups often lack transparency. The majority of the FAA commercial space committees or workgroups are internal groups within FAA Lines of Business (LOB) or FAA and the commercial space private sector which ALPA does not have access to. Proprietary information is usually cited as the reason provided to external stakeholders for exclusion from the ongoing dialogue between the FAA and the commercial space operators.

ICAO industry response (Dr. Fang Liu)

On May 14, 2021, I sent a letter to ICAO secretary general Dr. Fang Liu calling attention to the threat posed by the reentry of debris from orbit as commercial space operations continue to grow in frequency and—in recent months, two uncontrolled reentries of rockets.

In the letter, I urged ICAO to work with the United Nations to develop global standards for launch planning and recovery, to promote standards for vehicles that are designed to burn up entirely upon reentry, to work with national regulators and air navigation service providers to provide timely warning of any reentry, and to have procedures to route aircraft away from potential reentry hazards.

Dr. Fang Liu, ICAO Secretary General, responded to my letter assuring me that "the primary objective of ICAO remains the safety of international civil aviation". Dr. Liu highlighted ICAO's involvement with civil aviation authorities, air navigation service providers, and inter-governmental organizations in accordance with Assembly Resolution A40-26 and the UN Committee on the Peaceful Uses of Space. However, the response lacked detail how ICAO provides specific guidance that prevents future events like those that I highlighted in my testimony.

Are stakeholders taking safety concerns seriously.

While the commercial space industry and FAA state that safety is a priority, we are concerned that their response to commercial space transportation safety is inad-

equate. There still seems to be the consensus that the “big sky” theory is acceptable. What I mean is that there is a small likelihood of a collision between rocket debris and an air carrier aircraft, simply because there is so much airspace. Many believe the risk is acceptably small. However airline operations abandoned this belief long ago after several mid-air collisions, and Congress has required all commercial airliners to carry equipment to avoid a mid-air collision for nearly 30 years¹.

On December 9, 2020 SpaceX tested their Serial Number 8 (SN8) Starship prototype at their Boca Chica, Texas facility—which was conducted in violation of its launch license issued by the FAA². Elon Musk, founder of SpaceX and the company’s Chief Executive Officer (CEO), admonished the FAA (via Tweet) as hindering progress of the commercial space industry. As you may be aware, the spacecraft exploded during the landing sequence, spreading debris into the air and surrounding community. I’m sure you would agree that this was a serious violation of safety and undermined FAA’s authority in this area.

A significant element in the discussion on the level of safety of commercial space operations, is that Commercial Space uses a different safety standard than aviation. In commercial space there is an “expected casualty” limit for an uninvolved member of the public should be no greater than 1 in 10,000 flights, with a risk to any individual not exceeding 1 in 1 million. In contrast, aviation’s target level of safety is that a fatality should not occur more often than 1 in 1 *billion*, or 1000 times more stringent.

If commercial space were isolated and had no impacts on aviation, this might be acceptable. The problem is that commercial space and aviation operations share the same limited resource, the national airspace.

In an attempt to reconcile this difference, the FAA has introduced increased risk to traditional NAS stakeholders under the Acceptable level of Risk (ALR) concept. The concept initially managed the increased risk through exposure to potential falling debris based on a space vehicle’s trajectory. The concept was recently revised and now allows the aircraft to operate along the same trajectory/flight path of the space vehicle. In the event of a debris generating event, commercial airline aircraft will have to rely on ATC procedures and capability to clear the impacted airspace before falling debris reaches the aircraft.

The FAA currently does not plan to notify aircraft of the possibility of debris hazard under this new concept, and therefore pilots and operators will be unable to take action on their own to avoid this additional risk.

Plans to confront safety issues in their future work:

The FAA has started to focus more on integration of space operations as evidenced by the May 2020 space integration Concept of Operation. The FAA envisions real-time analysis and data sharing between commercial space operators and the FAA because the FAA will have telemetry information from the spacecraft which will allow them to calculate hazard areas in real-time as the spaceflight progresses. FAA would clear aircraft from the airspace that will be used by the spacecraft, as well as the immediate surrounding area where a spacecraft mishap would result in a serious hazard.

If a spacecraft mishap occurs, the immediate surrounding area would already be clear of aircraft. The FAA would then take actions in real time to move aircraft using real-time calculations away from where spacecraft debris would fall. This capability is predicated on reliable and real-time communications of spacecraft telemetry.

It is further assumed in the FAA Concept of Operations that airworthiness standards would be issued by the FAA, allowing the reliability of spacecraft to also be taken into consideration. Without the airworthiness standards for the spacecraft to help reduce the likelihood of catastrophic events, it is unlikely that integration of commercial space operations can be achieved.

ALPA is ready and willing to assist the FAA as it evolves the management of space launches, so that a single level of safety can be provided at all times.

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¹See Regulatory History section, <https://www.federalregister.gov/documents/2001/11/01/01-27340/collision-avoidance-systems>

²<https://spacenews.com/spacex-violated-launch-license-in-starship-sn8-launch/>