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Before the

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Committee on Science, Space, and Technology

Subcommittee on Space and Aeronautics

Risks and Rewards: Encouraging Commercial Space Innovation While Maintaining Public Safety

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The title of the Hearing – "Encouraging Commercial Space Innovation While Maintaining Public Safety" – taps directly into the FAA's mandate under the Commercial Space Launch Act ("CSLA"): To promote the commercial space transportation industry while maintaining public safety. Lo and behold, the FAA has succeeded: We have a thriving space transportation industry and, touch wood, have not had a major public safety event.

Yet, regulatory challenges remain that complicate and delay the licensing process and hamper industry progress. I discuss these challenges at pages 4-7 below and provide ideas for how they could be mitigated by prioritization of tasks and targeted allocation of resources and by reducing uncertainty and the timeline for licensing at pages 7-9. I briefly touch on the issue of expanded jurisdiction for AST at pages 9-10.

My experience with launch licensing goes back to the early-1990s (when the Office of Commercial Space Transportation was a small office within the DOT, before the delegation of responsibility for commercial launch licensing to the FAA in 1995). Both the licensing rules and the space office, now known as "AST" for the Associate Administrator for Commercial Space Transportation, have evolved substantially since then – in step with developments in the commercial space industry and legislation expanding the FAA's jurisdiction.

Background

The last major overhaul of launch licensing rules happened 18 years ago.[1] The rules adopted then were modeled in large part on the safety standards and requirements at Federal ranges.[2] These rules were well suited for traditional expendable launch vehicles (ELV) launching from Federal launch sites under an FAA license. But they were ill-suited for new launch vehicle concepts – such as vehicles incorporating foreign rocket stages, reusable launch vehicles, vehicles incorporating elements of reusability, air-launched launch vehicles, suborbital rockets, and human spaceflight. The result was a patchwork of different regulatory regimes.[3]

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1 Licensing and Safety Requirements for Launch, FAA, 71 Fed. Reg. 50507 (Aug. 25, 2006) (adding Part 417).

2 *See* 71 Fed. Reg. at 50509 ("codif[ying] the successful safety measures that the Department of Defense and NASA have implemented at Federal launch ranges").

3 *See* Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing Regulations, FAA, 65 Fed. Reg. 56618 (Sept. 19, 2000) (adding Part 431, Launch and Reentry of a Reusable Launch Vehicle (RLV); Part 433, License to Operate a Reentry Site; Part 435, Reentry of a Reentry Vehicle Other Than a Reusable

The FAA adopted Part 450 in 2020[4] to consolidate the different regulatory regimes into one set of rules, a single licensing regime. This was intended to streamline and facilitate licensing. The results are mixed. Part 450 is voluminous and complex, a bit of a maze. It is hard to navigate and understand and often requires license applicants to seek outside legal counsel to figure out how to comply.

14 C.F.R. Part 450

As noted, the FAA, AST has a dual mandate: Ensure public safety and promote the commercial space transportation industry.[5] Part 450 was adopted in response to a concern that the second aspect of the mandate did not get sufficient attention. Part 450 was prompted by Space Policy Directive-2, Streamlining Regulations on Commercial Use of Space (May 24, 2018), which required the Secretary of Transportation (and by delegation the FAA, AST) to minimize regulatory uncertainty and to promote economic growth.

Part 450 was well-intentioned in that it consolidated the separate licensing regimes for launches (by ELVs, reusable launch vehicles, and suborbital rockets) and reentries into one set of rules.[6] The idea was to streamline and facilitate the licensing process, e.g., by giving applicants a single licensing regime with more flexibility in how they meet safety requirements and standards.[7]

Part 450 implements the FAA's mandate to license launches and reentries "consistent with public health and safety, safety of property, and the national security and foreign policy interests of the United States."[8] Part 450 is primarily concerned with safety of launch, flight and reentry as part of AST's safety review, but it also includes rules for policy review (focusing on national security

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Launch Vehicle (RLV)); Licensing and Safety Requirements for Operation of a Launch Site, FAA, 65 Fed. Reg. 62812 (Oct. 19, 2000) (adding Part 420, License to Operate a Launch Site); Human Space Flight Requirements for Crew and Space Flight Participants, FAA, 71 Fed. Reg. 75616 (Dec. 13, 2006) (adding Part 460, Human Space Flight Requirements).

4 Streamlined Launch and Reentry License Requirements, FAA, Final Rule, 85 Fed. Reg. 79566 (Dec. 10, 2020) (effective March 10, 2021 and adding 14 C.F.R. Part 450) ("Part 450 Final Rule").

5 *See* 51 U.S.C. §§ 50901(b); 50903(b), (c); 50903(a).

6 *Part 450 Final Rul*e, 85 Fed. Reg. at 79567 ("This rule amends 14 CFR parts 415, 417, 431, and 435 by consolidating, updating, and streamlining all launch and reentry regulations into a single part 450."). *See* 14 C.F.R. §§ 450.45(e)(5), 450.207 (for human spaceflight, an applicant must comply with Part 460).

7 *Part 450 Final Rule,* 85 Fed. Reg. at 79567.

8 51 U.S.C. § 50905.

and foreign policy implications) (§ 450.41), payload review (§ 450.43), and environmental review (§ 450.47).

Part 450 requires two major sets of analyses: Flight Safety Analysis and Functional Hazard Analysis:

- A Flight Safety Analysis must identify risks associated with launch/reentry[9] to demonstrate compliance with safety criteria and casualty thresholds. This includes analyses of, e.g., trajectories for normal flight and malfunction, hazardous debris characterization, population exposure, probability of failure, flight hazard areas, debris risks, and far-field overpressure blast effects.[10]

- A Functional Hazard Analysis is used to determine the hazard control strategy best suited for the type of vehicle. Flight abort (controlled ending of flight) is the traditional approach for ELVs. Reusable launch vehicles typically require the applicant to perform an involved flight hazard analysis[11] if "public safety hazards cannot be mitigated adequately" using the hazard control strategies of physical containment, wind weighting, or flight abort.[12]

Part 450 promised a more flexible licensing regime: Rules would to a great extent be performance-based rather than prescriptive, meaning they would give increased flexibility to applicants in how they could meet a particular requirement or standard. In addition, Part 450 offers alternative ways to meet or avoid regulatory requirements (flexibility options):

- Demonstrate Equivalent Level of Safety (ELOS) in lieu of compliance with a requirement (§ 450.37).[13]

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9 14 C.F.R. § 450.113. Certain exceptions apply (*e.g.*, § 450.113(b)).

10 *See Part 450 Final Rule*, 85 Fed. Reg. at 79571.

11 A flight hazard analysis must "[i]dentify all reasonably foreseeable hazards, and the corresponding failure mode for each hazard, . . . [a]ssess each hazard's likelihood and severity, [e]nsure that the likelihood of any hazardous condition that may cause death or serious injury to the public is extremely remote, [i]dentify and describe the risk elimination and mitigation measures required to [ensure the risk to the public is extremely remote]," and "[d]ocument that the risk elimination and mitigation measures achieve the [extremely remote] risk level . . . through validation and verification." *See* 14 C.F.R. § 450.109(b).

12 14 C.F.R. § 450.107(c).

13 This option is broadly available. *See Part 450 Final Rul*e, 85 Fed. Reg. at 79575 ("In the NPRM, the FAA proposed in § 450.37 (Equivalent Level of Safety) that for all requirements in part 450, except § 450.101, an

- Demonstrate reliability through operational and flight history as an alternative to a flight safety analysis (§ 450.113(b)).
- Propose a special means of compliance (MOC) with a regulatory requirement (as agreed beforehand by AST) (§ 450.35(b)).
- Apply for a waiver of the regulatory requirement (§ 450.37).

Issues with Part 450

This set-up sounds simple, but in practice it is not. Performance-based standards while helpful are a two-edged sword – it takes a longer time to evaluate whether the regulatory goal is met for a performance-based standard than to check off the box that a prescribed method has been followed. Advisory Circulars ("AC") are in some cases available to guide applicants to acceptable means of compliance with performance-based standards.[14] The AST has adopted 21 ACs in all since 2020,[15] but many important safety requirements in Part 450 remain without guidance[16] and applicants are left having to propose a means of demonstrating compliance with the standard which may or may not be acceptable to AST.

Likewise, the alternative ways of meeting regulatory requirements (flexibility options) are not always available and the criteria for using them can be difficult to meet. Also, the regulator's evaluation of whether the criteria are satisfied can be time consuming and require the applicant to produce additional analysis and documentation.

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applicant may clearly and convincingly demonstrate that an alternative approach provides an equivalent level of safety (ELOS) to the requirement. In the final rule, the FAA revises § 450.37 so that only some portions of § 450.101—specifically § 450.101(a), (b), (c)(1), (c)(3), (d), (e)(1), and (g)—are excluded from eligibility for an ELOS approach.").

[14] *Part 450 Final Rul*e, 85 Fed. Reg. at 79567 ("Where possible, the FAA has adopted performance standards, and considered the prescriptive requirements for placement in advisory circulars (AC) that will identify possible means of compliance, but not the only means of compliance, with this rule.").

[15] Federal Aviation Administration, Commercial Space Advisory Circulars (ACs), https://www.faa.gov/space/legislationregulationguidance/commercial-space-advisory-circulars-acs/commercial-space (last visited Sept. 4, 2024).

[16] For example, AC 450.115-1B (issued Aug. 2, 2024) refers to important ACs that have not yet been published: AC 450-113-1, Level of Fidelity; AC 450.119-1, High-Fidelity Malfunction Trajectory Analysis; and AC 450.137-1, Distant Focusing Overpressure (DFO) Risk Analysis. Likewise, AC 450.117-1 (issued Aug. 19, 2021) refers to ACs that also have not yet been published: AC 413.5-1, Pre-Application Consultation; AC 450.115-2, Medium-Fidelity Flight Safety Analysis; AC 450.119-1, High-Fidelity Malfunction Trajectory Analysis.

- Take for example, ELOS – here, an applicant must to show that, even though it is doing things differently than what the rule calls for, the method it is using is equally safe. The standard is high: The applicant must "clearly and convincingly" demonstrate ELOS (§ 450.37). ELOS is also not available for certain critical safety requirements,[17] e.g., the thresholds for injury and damage to the public at large, individuals and aircraft in flight and critical safety areas.

- Likewise, waivers of regulatory requirements are not always easy to obtain and may not be possible to obtain. An applicant needs to show that not complying with a regulatory requirement is in the "public interest" and will not jeopardize the public health and safety, safety of property, and national security and foreign policy interests" of the U.S.[18]

In addition, the timelines for the licensing process are not always clearly defined. Take, for example, the standard an applicant must meet in order to transition from "pre-application consultation" to the AST's acceptance of a license application for initial review: For this to happen, the application must be "complete enough."[19] The standard is vague.[20] An applicant must sort through a 69 page Advisory Circular[21] to determine what information must be submitted in order for the application to be "complete enough" to submit for initial review.

The "complete enough" standard is important because it is then that the 180 day statutory review period for AST to make a licensing decision begins to run.[22]

An applicant may request that AST undertake an "incremental" safety review,[23] but in that case, the 180 day statutory review period does not apply; instead, "an agreed upon review period will begin once the FAA has a complete enough application in its entirety."[24] In practice, this

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17 *Part 450 Final Rul*e, 85 Fed. Reg. at 79575 ("[§]§ 450.101(a), (b), (c)(1), (c)(3), (d), (e)(1), and (g)—are excluded from eligibility for an ELOS approach.").

18 51 U.S.C. § 50905(b)(3); 14 C.F.R. § 450.37.

19 14 C.F.R. § 414.19; *Part 450 Final Rul*e, 85 Fed. Reg. at 79578.

20 14 C.F.R. § 414.19; *Part 450 Final Rul*e, 85 Fed. Reg. at 79578 ("must include enough information for the FAA to start its review [of the application]").

21 Guidance on Submitting a Complete Enough and Complete Application for a Vehicle Operator License, AC 413.13-1 (Dec. 18, 2023).

22 *Part 450 Final Rul*e, 85 Fed. Reg. at 79579 ("The FAA begins the calculation of the 180-day statutory review period on the date that it receives the information needed to make the application complete enough, regardless of how long it takes to make that determination.").

23 14 C.F.R. § 450.33 (Incremental Review and Determinations); *Part 450 Final Rul*e, 85 Fed. Reg. at 79578.

24 *Part 450 Final Rul*e, 85 Fed. Reg. at 79586.

approach entails considerable uncertainty, which can complicate the applicant's business planning.

The pre-application process also requires applicants to identify the means of complying with certain key safety requirements in Part 450, which must be accepted by AST before the application can be submitted.[25] In addition, for vehicles that pose unique safety hazards not addressed in Part 450[26] applicants are advised to seek acceptance of their proposed means of compliance prior to submitting their application.[27] Preparing all this and getting the AST's signoff before submitting the license application can be unduly burdensome.

The sheer volume and complexity of Part 450 (and accompanying ACs) also means that processing the application once submitted is time-consuming. This is further exacerbated by the practice of tolling the 180 day statutory review period. Part 450 permits tolling where the accepted license application does "not provide sufficient information to continue or complete the reviews or evaluations required . . . ."[28] The AST may stop the clock on the review period until it gets the information it requires.[29] This is especially concerning for new launch vehicle concepts or technologies where the need for information, reviews and analysis is typically greater.

Delay in processing of license applications may also result from a constrained resource environment. Where that is so, a judicious allocation of resources and prioritization of focus by AST become all the more important.

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[25] *See* 14 C.F.R. § 450.35(a) ("Prior to application acceptance, a means of compliance must be accepted by the Administrator for the following: (1) Section 450.115(b)(1) regarding flight safety analyses; (2) Section 450.139(e)(1) regarding toxic hazards for flight; (3) Section 450.145(b) regarding highly-reliable flight safety system; (4) Section 450.163(a)(1) regarding lightning hazard mitigation; and (5) Section 450.187(e)(1) regarding toxic hazards mitigation for ground operations."); AC 413.13-1, s. 6.1.1. (noting that an "applicant must submit the MOC [means of compliance] for these five topics for FAA acceptance prior to the license application review period"). AC 413.13-1, s. 6.1.3 (listing the six types of acceptable means of compliance that the FAA has identified).

[26] *See* 14 C.F.R. § 450.177.

[27] *See* AC 413.13-1, s. 6.1.2.

[28] 14 C.F.R. § 413.15(b).

[29] Streamlined Launch and Reentry Licensing Requirements, FAA, NPRM, 84 Fed. Reg. 15296, 15302 (Apr. 15, 2019) (discussing tolling under the legacy rules: three out of 10 licensing determinations (the last ten new license determinations through calendar year 2018) were tolled for 73, 77, and 171 days).

Directions to Consider

Granted, the FAA has an awesome responsibility in keeping the general public safe given a diverse and growing launch industry and asking for more may seem unreasonable. Nonetheless, below are some ideas for the Subcommittee to consider as possible direction to AST in a constrained resource environment:

- Align licensing priorities with broader national interests by prioritizing the applications of entities that can demonstrate that the proposed launch will support missions with a clear and compelling national interest or national security interest. This is arguably in line with the AST's licensing mandate to issue licenses consistent with the "national security and foreign policy interests of the United States."[30]

- Allocate personnel and resources strictly based on areas currently within AST's jurisdiction, *i.e*., licensing of launches, reentries, and operation of launch sites. This would exclude safety considerations relating to matters such as mission success and in-space payload operations and orbital debris. The AST's mandate concerns public safety of launch and reentry.[31]

- Limit payload reviews to those required for pending FAA launch license applications. Payload reviews for payloads intended for launch on foreign launch vehicles as a means of obtaining the U.S. Government blessing for the mission seem outside the purview of the FAA's present statutory authority.[32]

- Prioritize pending license applications over new pre-application consultations. This would ensure launch availability for payloads waiting to be launched and promote growth of the space industry. Launch providers that have achieved a certain launch cadence, in line with the aspirations of the CSLA, deserve to be treated favorably. On the other hand,

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30 *See, e.g.*, 51 U.S.C. §§ 50901(b)(3); 50905(a)(1).

31 51 U.S.C. § 50905(a).

32 *See* 14 C.F.R. § 450.43(d) ("a payload owner or payload operator may request a payload review and determination."); 51 U.S.C. § 50904(c) ("[i]f no license, authorization, or permit is required [for a payload to be launched], the Secretary may prevent the launch or reentry if the Secretary decides the launch or reentry would jeopardize the public health and safety, safety of property, or national security or foreign policy interest of the United States.").

such treatment favors existing players and risks stifling innovation. The pros and cons would need to be weighed.

- Direct AST to limit requests for information to what is strictly necessary to satisfy AST's public safety, national security and foreign policy mandate and avoid requests for information of general or scientific interest; avoid duplication of safety information, reviews and analysis;[33] set timelines for ELOS and MOC evaluations to the extent possible; and define terms such as "continuing accuracy."[34] These measures align with the direction to the FAA to simplify and expedite the licensing process.[35]

The Committee may also wish to ensure that AST is prepared for the transition to Part 450 of launch licensees currently operating under the legacy rules. To ensure that the transition can be accomplished without interruption of commercial launch operations, including AST-licensed launches of U.S. government payloads. (Some launch companies that had licenses at the effective date of Part 450 opted to continue operating under the old regulations.) The deadline for the transition is March 10, 2026.[36]

Finally, the Committee may wish to consider legislation giving the FAA the authority to issue experimental permits also for *orbital* launch and reentry. At present, this authority is limited to suborbital flights.[37] Such permits are available for testing, showing compliance with regulatory requirements, and crew training.[38] Permits offer added flexibility in that the permittee may conduct an unlimited number of launches or reentries for a particular rocket design.[39] The

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[33] For example, if applicant meets a specific Federal range requirement, that should be sufficient. Likewise, if an aircraft used for as a carrier vehicle for an air-launched launch vehicle has obtained an experimental aircraft certificate from the FAA, it should not be necessary to duplicate a safety analysis completed for that purpose.

[34] 14 C.F.R. §§ 417.11 (legacy rules), 450.211.

[35] *See* 51 U.S.C. § 50101 ("(1) to promote economic growth and entrepreneurial activity . . . ; [and] (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 . . . ."); Space Policy Directive-2, Streamlining Regulations on Commercial Use of Space (May 24, 2018),

[36] *Part 450 Final Rul*e, 85 Fed. Reg. at 79567 ("After March 10, 2026, parts 415, 417, 431, and 435 will be removed.").

[37] *See* 51 U.S.C. § 50906(d) ("The Secretary may issue a permit only for reusable suborbital rockets or reusable launch vehicles that will be launched into a suborbital trajectory or reentered under that permit . . . ."); 14 C.F.R. Part 437.

[38] 51 U.S.C. § 50906(d).

[39] 51 U.S.C. § 50906(e)(1).

statutory review period for a permit is shorter (120 days).[40] Experimental permits for orbital launches and reentries would be similar to the Federal Communications Commission's ("FCC") practice of issuing experimental permits for satellites under 47 C.F.R. Part 5 for similar purposes.

Additional Jurisdiction for AST

There has been debate for at least two decades about the need to authorize space objects or vehicles operated by U.S. private entities that do not fit within the three established licensing regimes for satellite communications,[41] space transportation[42] and satellite remote sensing.[43] The need for such legislation is anchored in Article 6 of the Outer Space Treaty, which requires the "authorization and continuing supervision" of non-governmental entities by a State party to the treaty.[44] Another rationale for such regulations is to provide certainty to prospective investors in new space ventures that a path to Government authorization exists for the mission.

The discussion has centered primarily on these topics: (1) which government agency should be designated as the focal point for authorizations – the Department of Commerce and the FAA, AST being the two agencies in play, (2) what form should the authorization take, (3) what scope of activities should be included, (4) what the criteria for authorization should be, (5) what the relationship to other authorizing agencies regulating space operations should be, and (6) whether the operator should be responsible or liable for damage it causes if the U.S. Government incurs treaty liability as a result.[45]

Many bills have been introduced over the years. 2023 saw this Subcommittee put forth the Commercial Space Act of 2023,[46] which set up a certification process with minimal criteria. Responsibility of certification would rest with the Secretary of Commerce, with delegation to the

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[40] 51 U.S.C. § 50906(a) ("the Secretary, not later than 120 days after receiving an application pursuant to this section, shall issue a permit if the Secretary decides in writing that the applicant complies . . .").

[41] 47 U.S.C. § 301 et seq.; 47 C.F.R. Part 25.

[42] 51 U.S.C. §§ 50901-50923; 14 C.F.R. Parts 400-460.

[43] 51 U.S.C. §§ 60101-60162; 15 C.F.R. Part 960.

[44] Treaty Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 18 U.S.T. 2410, 610 U.N.T.S. 205 (done Jan. 27, 1967) ("Outer Space Treaty"), art. VI ("The activities of non- governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.").

[45] *See Outer Space Treaty*, arts. VI, VII; Convention on International Liability for Damage Caused by Space Objects, 24 U.S.T. 2389, 961 U.N.T.S. 187 (done Mar. 29, 1972).

[46] H.R. 6131 (118th Cong.).

Office of Space Commerce. The White House proposed legislation shortly after the Subcommittee introduced its bill,[47] expanding the jurisdiction for AST over human spaceflight to also include on orbit activities, which are currently outside AST's purview. Neither bill resulted in legislation.

The While House proposal would amend the CSLA to define a "human space flight vehicle" to include a launch or reentry vehicle, habitat, or other object, built to operate in suborbital trajectory or outer space, including on a celestial body, with a human on board, and a license would be required to operate such a vehicle. The suitability of such legislation must be carefully considered in terms of, e.g.: (1) the AST's current work load, (2) AST's present experience with and state of regulatory preparedness for human spaceflight, (3) AST's lack of experience with regulating orbital flight, and (4) whether any other agency is better suited. Any additional responsibility for AST would obviously require additional resources.

Respectfully Submitted,

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[47] Novel Space Activities Draft Legislative Text, available at https://www.whitehouse.gov/spacecouncil/.