



Comments from the
Commercial Spaceflight Federation
in regards to

Docket No. FAA-2019-0229

Streamlined Launch and Reentry
Licensing Requirements
Notice of Proposed Rulemaking

August 19, 2019

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Introduction

The Commercial Spaceflight Federation (CSF), is a trade association that represents over 80 entities within the commercial spaceflight industry. Following review by members who are launch operators, spaceports, suppliers, universities, and museums, CSF respectfully submits that the new regulations for launch and reentry licensing will have a lasting impact on our various members and the future of American commercial spaceflight. Therefore, it is of the utmost importance to CSF that the final rule resulting from this effort provide a regulatory framework that will allow for a safe, efficient, innovative, and internationally competitive U.S. commercial space industry.

We are thankful for the opportunity to provide input on the Federal Aviation Administration's (FAA) Notice of Proposed Rulemaking for Streamlined Launch and Reentry Licensing Requirements (the "NPRM"), as published in Docket # 2019-0229, and we appreciate the on-going work by the FAA Office of Commercial Space Transportation (FAA AST) to revise its regulations to promote safety through an efficient and flexible licensing regime.

While CSF is encouraged by the FAA's enthusiasm to progress the rulemaking process on an advanced timeline, we encourage the FAA to prioritize substance over speed as it establishes the licensing framework for the nation's commercial space launch and reentry endeavors in a manner that will ensure safety and excellence. We respectfully submit the following comments on the materials that were entered into Docket #2019-0229 by August 16, 2019. We note that our ability to fully comment on the substance of the regulations was hindered by the fact that the NPRM references guidance documents that are not yet published as well as the fact that FAA did not provide clarification to questions raised in the Docket prior to July 29th, 2019, until the afternoon of Friday, August 16th (only a partial business day before the comment period closure). Industry members have submitted multiple comments, concerns, and clarification requests, many of which share themes with the substance of the CSF submission that follows.

In addition to submitting extensive comments herein, CSF posits that the quantity and diversity of those comments, concerns, and clarification requests support our recommendation the FAA issue a revised Supplemental NPRM as an interim step and additional opportunity for engagement before publishing a final rule. Such a SNPRM would be most effective and allow for the best inputs if it is accompanied by the publication of Advisory Circulars (ACs) that are referenced or necessitated by the NPRM.

The Draft Rule published in the NPRM relies upon prescriptive regulations, which is contrary to SPD-2's goal to utilize performance based regulations.

It is the opinion of CSF that the NPRM does not meet the intent of Space Policy Directive 2 (SPD-2) nor the Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee (SLRLR ARC) report recommendations. Applicants for FAA AST-issued launch and reentry licenses currently apply under Title 14 of the Code of Federal Regulations (CFR), Chapter III. Parts 415 and 417 of Title 14, Chapter III govern expendable launch vehicles and were largely copied from the U.S. Air Force Federal Range requirements in Air Force Space Command Manual (AFSPCMAN) 91-710, which are prescriptive and, as adopted in the FAA regulations, have consistently proven

inflexible for the commercial launch and reentry industry's current pace of operations and technology development.

Title 14, Chapter III of the CFR also includes Parts 431 and 435, which adopt a performance-based approach to assessing a license application. U.S. commercial space operators are operating safely under Part 431 licenses, showing that a performance-based, system safety approach to regulation can ensure safe operations. While 14 CFR Parts 431 and 435 offer an alternative to the prescriptive approach in Parts 415 and 417, the FAA has consistently been unable to provide applicants applying for approvals under Parts 431 and 435 with sufficient explanatory documents, such as Advisory Circulars (ACs), that define acceptable means of compliance. This lack of support structure results in great and protracted negotiations between applicants/operators and FAA; lack of clarity and program risk for applicants/operators; and often results in the FAA licensing teams relying on knowledge and approaches used in the prescriptive requirements of Parts 415/417. Because SPD-2 directed performance-based regulations, it was CSF's hope (and it also seemed an obvious path) that FAA would make Parts 431/435 the basis of the proposed rulemaking and build upon that with a focus on accepted means of compliance and advisory circulars. A task force of the SLRLR ARC proposed an entire set of regulatory language that used Part 431/435 as a basis for updated rules. FAA inappropriately ignored this proposed set of regulations,¹ claiming that the majority of the ARC opposed the formation of this task group, and that the resulting proposed regulations did not receive broad consensus within the ARC. In fact, the ARC records do not reflect that a majority of the ARC opposed the formation of the task group (65%² of the ARC members who submitted ballots³ supported the report including the draft regulatory language)⁴, and there is no such requirement in the ARC charter that a proposal must receive "broad consensus" in order for FAA to address a proposal. Given that 13 out of 20 participating ARC members supported the work of the task force as evidenced by the votes of the group, CSF finds significant error in the fact that FAA ignored this proposed regulatory text.

Instead, FAA started this effort using Parts 415 and 417 as a basis, rule sets that are heavily prescriptive. Given that only one draft advisory circular was included in the docket, and 17 others identified have not yet been developed for industry's review, CSF in some cases is limited in its ability to provide substantive comments because our members lack the insight necessary to understand how FAA will implement these regulations. In many cases, there are prescriptive requirements "hard coded" into the regulations, resulting in a general lack of flexibility for industry to provide alternative means of compliance.⁵ In other cases, the proposed rules could be performance based, but it is hard to tell whether FAA intends to implement them the way that industry assumes they will be implemented, given that FAA has not produced most of the ACs at this time.

¹ NPRM, 15301. Notice of Proposed Rulemaking of the Federal Aviation Administration (FAA), *Licensing Private Remote Sensing Space Systems*, Notice of Proposed Rulemaking, 84 Fed. Reg. 21282 (May 14, 2019) ("NPRM").

² This calculation includes a late ballot from Astra Space. Not including this ballot, the percent of supporters is 63%.

³ Three companies were invited to the ARC but did not participate in the discussions or submit a ballot. They have been removed from these calculations altogether. One company submitted a vote of "abstain" which has also been removed.

⁴ SLRLR ARC Report, Appendix F

⁵ We provide specific review of the flexibility of the proposed rules later in these comments.

An example of the prescriptive approach of these rules is proposed §450.101(c). Looking at the entirety of proposed §450.101, the collective and individual risk requirements of §450.101(a) and (b) are the hallmarks of a performance based approach, dictating what level of safety must be met by the operator. The problem comes with proposed §450.101(c) which states:

(c) Flight abort. An operator must use flight abort with a flight safety system that meets the requirements of § 450.145 as a hazard control strategy if the consequence of any reasonably foreseeable vehicle response mode, in any one-second period of flight, is greater than 1×10^{-3} conditional expected casualties for uncontrolled areas. This requirement applies to all phases of flight, unless otherwise agreed to by the Administrator based on the demonstrated reliability of the launch or reentry vehicle during that phase of flight.⁶

This requirement is prescriptive and against the performance based direction of SPD-2. The collective and individual risk criteria are the “what,” this requirement specifies the “how.” This is exactly the opposite of a performance based approach, which allows flexibility for the operator to propose how it will meet the individual and collective risk requirements of § 450.101(a) and (b). Any suggestions as to “how” to comply with a requirement belongs in an AC. Interestingly in this case, flight abort (the prescribed requirement in section (c)) may actually **increase** risk during overflight where vehicle hazards cannot be contained. So, this prescriptive requirement potentially reduces the safety posture of the operator, who has no ability to propose another approach, as explained below, because FAA has built no flexibility into this requirement.

A Final Rule should increase flexibility to support a diverse, innovative industry.

A hallmark of performance based regulations is that they allow flexibility in implementation. While the Draft Rule proposed in the NPRM makes important changes to increase flexibility as compared to the current regulations in 14 CFR Parts 415 and 417, flexibility improvements were reduced by removing Parts 431 and 435, which are performance based and therefore inherently more flexible. The NPRM also misses the mark on allowing an applicant to work with the FAA to “tailor” the requirements to specific programs or for new technology. The agency’s approach risks being quickly outdated and discouraging innovation.

The Draft Rule would continue to allow requests from licensing applicants for waivers and equivalent levels of safety (ELOS). Importantly, though, the FAA proposal works to decrease the need for burdensome and time-consuming waiver requests by addressing some (though not all) of the recurring scenarios that have consistently required waivers. If implemented properly by FAA—specifically, in concert within their jurisdiction to ensure public safety and to further encourage, facilitate and promote the commercial industry—the tools identified below will offer flexibility improvements.

⁶ NPRM, 15427.

Equivalent Level of Safety (ELOS)

The NPRM states the FAA's intent to allow applicants to propose an equivalent level of safety (ELOS) as an alternative to any requirement:

For any particular requirement, the FAA would maintain the ability for an applicant or operator to propose an alternative approach for compliance, and then clearly demonstrate that the alternative approach would provide an equivalent level of safety to the requirement.⁷

Unfortunately, the NPRM's proposed regulatory text appears to conflict with the text in the NPRM's preamble cited above. There are instances in proposed part 450 where an ELOS is not actually allowed. Proposed § 450.37 specifically states ELOS is not available for § 450.101. CSF does not agree with preventing an ELOS determination for § 450.101(c). If an applicant has reason to propose an alternative approach to a flight safety system compliant with § 450.145 for high consequence events, they should be allowed to "demonstrate that the alternative approach would provide an [ELOS] to the requirement."⁸ Furthermore, in many of the other sections of the proposed rule that are highly prescriptive (e.g., software in § 450.111 and flight safety analysis in §§ 450.117-450.141) CSF disagrees with baselining a prescriptive approach that will drive applicants and operators into a burdensome ELOS process as a default. We remind FAA again of the benefit of the Part 431/435 approach – the ELOS process does not exist under those regulations because it is not necessary. What is necessary is a robust set of ACs that define accepted means of compliance. Such an approach should be the focus of these regulations.

Accepted Means of Compliance

FAA's proposed *Acceptable Means of Compliance* regulation (§ 450.35) appears to be limited to only those rule sections that are listed in the draft Accepted Means of Compliance Table.⁹ That table should be expanded. For example, § 450.101(c) should be included in the table to allow an accepted means of compliance with § 450.101(c) other than a flight safety system (FSS) compliant with § 450.145 as the hazard control strategy.¹⁰ The ARC proposed a qualitative approach to determining the appropriate type of flight safety system, and that approach could be captured in an AC associated with § 450.101(c), which would allow for alternative approaches. CEc is an example of an acceptable means of compliance that could also be included in this AC as another means of determining the type of flight abort to incorporate.¹¹

⁷ NPRM, 15301.

⁸ *Id.*

⁹ *Part 450 Subpart C Accepted Means of Compliance Table Draft for Docket*, FAA-2019-0229 (April 22, 2019)

¹⁰ As discussed later in these comments, the way Conditional Expected Casualty (CEc) is currently codified in proposed § 450.101(c) makes a FSS compliant with § 450.145 the sole means to meet the requirements rather than one means of compliance, which is the approach a performance based rule should apply.

¹¹ Please see the discussion in these comments on Conditional Expected Casualty for further discussion of CEc and why CSF does not feel it is appropriate to have codified in the regulations as proposed.

“Unless otherwise agreed to by the Administrator”

The NPRM introduces this option as an alternative means of compliance in various portions of the proposed regulations. CSF supports this addition to increase flexibility over the current regulations. Footnote 44 to the NPRM establishes the intent of this clause:

The clause ‘as agreed to by the Administrator’ is used throughout the proposed regulations Where the clause is used, it means that an operator may submit an alternative to the proposed requirement to the FAA for review. The FAA must agree to the operator’s proposal in order for the operator to use the alternative. By whatever means the FAA’s agreement to an alternative is communicated to the operator, the agreement means that the alternative does not jeopardize public health and safety and the FAA has no objection to the submitted alternative.¹²

Although the clause is used throughout the proposed regulations, it is unclear how this process differs from an ELOS determination. CSF requests that FAA describe its expectations and capture any “process” associated with this option in an AC. CSF notes that the allowance for proposing an alternative to the Administrator under this clause is excluded in certain important places. CSF recommends adding this flexibility in the following example:

- Proposed revision to § 450.101(c): Add at the beginning of section:

“Unless otherwise agreed to by the Administrator, an operator must use flight termination with a flight safety system that meets the requirements of § 450.145”

The only flexibility in this section is that an operator can request, based solely on vehicle reliability data that a FSS is not required as a hazard control strategy for certain phase of flight. CSF recommends allowing flexibility here to achieve a performance based result. Operators should be allowed to prove a new or different hazard control strategy that is not FSS for a specific phase of flight. They also should be able to propose relying on something other than vehicle reliability data to argue their case. FAA should allow those operators to plead their case through a determination by the Administrator or an ELOS.

Launch and reentry licensing rules should be streamlined and supported with guidance documents.

CSF recommends revising the NPRM¹³ to ward against adding regulatory overhead by virtue of complexity, lack of clarity and overly prescriptive requirements. To address that problem, FAA should streamline the NPRM proposed rules through the use of guidance documents. SPD-2 clearly stated the Administration’s direction that proposed launch and

¹² NPRM 15310 - Footnote 44

¹³ In a number of references in this document, NPRM is intended to refer to the Draft Rule proposed by FAA

reentry licensing regulations be streamlined. CSF commends the FAA for working to achieve that goal; however, there are several cases where increased complexity and burdens are proposed as compared to the existing rule set. Together, with a streamlined Supplemental NPRM (SNPRM) the FAA should publish supporting guidance documents to ensure full transparency and public engagement.

In addition, we note that the term “prescribed controls” is used numerous times throughout the NPRM. CSF recommends that each of these be scrutinized for agreement with SPD-2 and that the FAA revise to the maximum extent possible by moving such requirements to advisory circulars.

Lack of Clarity and Guidance Documents

The FAA has the opportunity to revise the NPRM and develop guidance documents in a manner that will add clarity and positively impact the cost analysis and justification for its requirements. Below are recommendations to achieve that goal.

- *Adequate Clarity* – There are multiple areas within the NPRM that lack the adequate clarity required in order for companies to comment on the impact of the regulations on their operations, or even to comment on how an operator would comply with the respective requirements. This lack of clarity starts at the foundation of the requirements with definitions in 14 CFR Part 401 and is carried on through the length of the NPRM. Greater detail on these concerns is provided later in these documents.
- *Supporting Guidance Documents* – The NPRM contains multiple references to guidance documents and ACs that are not yet published in the Federal Register. For example, in § 450.35 Accepted Means of Compliance and the associated Table, there are 17 ACs called out that have yet to be developed or published for industry comment. We understand from the public discussion at the May 2019 meeting of the FAA’s Commercial Space Transportation Advisory Committee (COMSTAC) that the FAA is actively working on these AC documents and will publish them with the final rule. The difficulty with that approach is that it does not provide an opportunity to consider the proposed rules and the draft ACs as a complete package, which is how they will operate. CSF disagrees with this approach and reiterates its request that a SNPRM coupled with the identified guidance documents (ACs) be published together and in advance of a final rule.

The Final Rule should avoid unnecessary, increased burdens on FAA and applicants.

The NPRM contains multiple new prescriptive requirements that will increase the cost and burden on industry (e.g., software, flight safety analysis, CEC driving FSS design). These new requirements were not justified via their impact on public safety nor accurately analyzed for the cost on industry. If enacted, they have the ability to stunt the growth and pace of innovation and create an anti-competitive environment within the domestic commercial space sector. As a result, these requirements must be adequately justified

through the appropriate analyses for their existence. FAA's assessment of "cost savings"¹⁴ is severely inadequate in the following important areas:

- *Flight Safety Systems (FSS)* – CSF respectfully disagrees with the FAA's assessment of the cost savings from the NPRM's FSS requirements. The NPRM states:

*"The largest quantified cost savings for industry would result from eliminating or relaxing requirements for a flight safety system on some launches (about \$11 million in present value savings over 5 years at a discount rate of 7% or about \$12 million at a discount rate of 3%) . . ."*¹⁵

CSF stresses that this calculation appears to be a significant miscalculation – it will result in costs **increases**. First, the CEc is a new and costly calculation that may require significant resources, including possible reliance on contracts for expensive modeling capabilities.¹⁶ Second, the result of the CEc analysis based on our understanding of what is required by § 450.101(c) is that the majority (if not all) operators will be captured by § 450.145(a)(1) and will be required to implement an FSS of the highest reliability (whether large or small, orbital or suborbital, vertical/horizontal/hybrid). This will mean significant increases in cost and oversight burdens to every single operator not already operating at a US Federal range who has not yet implemented an FSS compliant with RCC 319-4.

- *Grandfathering* – CSF is concerned by the lack of clarity with regard to the grandfathering provision in the NPRM. Specifically, it should be clear that a licensee approved under the current licensing regime may continue to renew its approvals, assuming no significant changes, without having to reapply under the proposed Part 450. The FAA's statements below are counter to that approach:

*"The FAA would determine the applicability of proposed Part 450 to an application for a license modification submitted after the effective date of the part on a case-by-case basis."*¹⁷

*"An applicant for a renewal would be required to meet all the requirements of proposed part 450."*¹⁸

Should the FAA require licenses issued under the current regulations to seek renewals under Part 450, it will result in significant cost and regulatory burdens for operators and the FAA. For example, currently licensed operators under Parts 431 and 435 will have to come into compliance with the prescriptive portions of Part 450 (specifically addressed in other areas of this rule). These burdens would be lessened if the FAA had based its proposed Part 450 on the performance based content of Parts 431 and 435.

¹⁴ NPRM, 15405-15406, 15409

¹⁵ NPRM, 15405.

¹⁶ The lack of clarity with regard to calculating CEc and access to the information and modeling capabilities that CEc will require has been the subject of multiple questions and requests for clarification in the NPRM Docket.

¹⁷ NPRM, 15377.

¹⁸ NPRM, 15377.

- *Flight Safety Analysis (FSA)* – The prescriptive requirements in this section (§§ 450.113 - 450.141), and the associated lack of flexibility (i.e., lack of use of “unless otherwise agreed to by the Administrator”) means that there will be applicants for whom the prescriptive FSA sections just do not work. The proposed approach is directed at large orbital launchers from Federal ranges. Other architectures will not be able to comply with proposed regulations because they are wholly inappropriate for certain vehicles and operations. While we agree that every operator should conduct a flight safety analysis for every operation, this section is another example where the high level requirement to complete an analysis should be called out in the regulations (i.e., proposed §§ 450.113-115) and the rest of the proposed regulations that speak to how to conduct such an analysis (i.e., proposed §§ 450.117-450.141) should be moved to an AC. The content of proposed §§ 450.117-450.141 will not be applicable to every type of architecture. In addition, these sections do not include statements such as “unless otherwise agreed to by the Administrator”, resulting in no flexibility. Every operator will be held to this baseline of regulations. An applicant would need to propose an alternative accepted means of compliance to this baseline content, probably through an equivalent level of safety determination, or submit waiver requests to the regulations that wholesale do not apply to the architecture presented. Creating a baseline system that results in that amount of work is avoidable if FAA would propose a high level requirement to perform a flight safety analysis that addresses specific substantive areas (e.g., trajectory analysis, malfunction trajectory analysis, debris analysis, toxic hazards, etc.) and then use ACs that capture how to address each of those substantive areas. CSF recommends the following approach:

- only §§ 450.113-450.115 be retained in the next iteration of the proposed rule; and
- §§ 450.117-450.141 be removed from the proposed rule and included in AC content that should be released to industry in advance of the final rule being promulgated, ideally with a SNPRM whose content can be considered with the ACs that support it.

As with the CEc calculation, some applicants will suffer the cost of performing some of the analyses required in these sections due to lack of tool availability outside of the USG. FAA is creating a sole source scenario in these instances, and as industry has seen, when a USG tool becomes available by one commercial offeror at the direction of USAF or FAA, the prices typically are exorbitant. These aspects of the FSA sections and the resulting costs to applicants and operators have apparently not been included in FAA’s cost analysis, which characterizes the FSA regulations as bringing a resulting cost savings. CSF respectfully disagrees.

- *Independent Analysis* – The NPRM’s Flight Safety Analysis sections (§ 450.119 and § 450.135) include multiple references to an applicant submitting any “additional products that allow an independent analysis, as requested by the Administrator.”¹⁹ This behavior of recreating an applicant’s analysis is already an expensive and burdensome aspect of the current rules that should be ended by

¹⁹ For example sections 450.119, 450.135

the NPRM. FAA should not be in the business of recreating analysis already done by the applicant. There should be clearly stated ACs that guide and inform the analysis, and an applicant should provide sufficient proof that they have implemented an approved analysis method, with FAA verifying that method and the results. The use of FAA as an additional and independent verifier (i.e., recreating the entirety of the analysis) is inefficient in terms of time, cost, and regulatory oversight. This is a cost driver that many new entrants will not be prepared for. FAA should assess the costs associated with producing the deliverables (data files) that FAA will require to recreate the analysis and the multiple back-and-forth engagements with FAA to disposition disconnects between an applicant's analysis and FAA's analysis. These costs are significant.

In light of the above, CSF strongly recommends that FAA review the proposed rules with an eye to the additional burdens (cost and paperwork) that will be imposed on current licensed entities and those consultations on pending applications. A thorough review of this group of operators will provide concrete examples of where FAA's analysis of "cost savings" requires reevaluation and correction.

Adverse Impacts on Small Entities

CSF reviewed the FAA's initial regulatory flexibility analysis written in compliance with the Regulatory Flexibility Act and incorporated into the NPRM beginning on page 15407. CSF believes the FAA's analysis is substantially flawed.

The FAA significantly understates the number of small launch and reentry vehicle operators who will be impacted by this new proposed rule. The FAA only identifies two small companies currently in pre-application consultation, Vector and Generation Orbit. The FAA did not include other small operators and licensed or license-seeking spaceports, which are qualified small entities covered by the Act and will be impacted by the proposed rule. Many of these entities are CSF members, and at least 9-10 of the 24 organizations invited by FAA to participate in the ARC related to this rulemaking would qualify, we believe, as small entities as defined in the Act. In addition, there are small firms not in CSF's membership and which did not participate in the ARC which will be impacted by this proposed rule. The FAA made no effort to estimate the number of potential new startups which could reasonably be expected to be future applicants as a result of growth in this dynamic industry, and which would then be subject to the new rule.

Beyond the small entities not addressed in the analysis as noted above, the FAA's proposal would also impact small companies that are subcontractors, suppliers, or service providers to licensed launch or reentry operators, both in regard to a particular event and in the activities of neighboring operations not involved in a particular licensed or permitted event.

CSF believes several new proposed flight safety requirements will impose complex and costly risk analyses on small entities, in particular the new requirement for "consequence protection" (CEc analyses based on a 100% probability of failure for each second of flight) to determine the need for a Flight Safety System. Another new regulatory requirement requires risk analysis on each property asset the FAA designates as a "critical asset" in the national interest, with no clear explanation for how an applicant will gain access to such data to perform the analysis, particularly for operations from private

sites, or spaceports not located on Federal ranges. The proposed flight software requirements are also likely to be very complex and costly for small companies. Full root-cause analysis is burdensome and difficult even for organizations that have full Quality Assurance processes in place for flight software development.

We note elsewhere in these comments that duplicative or conflicting rules among overlapping Federal jurisdictions also create a barrier to entry for small startups. This unnecessarily increases the cost of space access to all users by forcing all providers to either pass those costs on to their customers (including the Government); or be denied the availability of new capabilities due to lack of bandwidth and resources. This will drive internationally-competed business to other countries to avoid the cost or schedule impacts arising from duplicative, conflicting, and overlapping rule sets.

CSF believes FAA must be especially attentive to addressing issues which may discourage entrepreneurs from bringing beneficial products and processes to enhance U.S. technological and operational leadership as well as improve safety across the industry.

The Draft Rule increases regulatory uncertainty for commercial space licensing applicants.

CSF is concerned with the proposed expansion of FAA's discretion to establish and impose new requirements on vehicle operators that amount to regulations in avoidance of the U.S. government's rulemaking process. The freedom of the commercial spaceflight industry to innovate and deliver to market new technologies that advance U.S. leadership in space are enabled by a high degree of regulatory certainty. This is especially evident by the advances of our industry in recent years, recapturing a major share of the global space commercial market, while enabling Government customers to use new commercial products and services that have lowered costs and increased availability of access to space, all without compromising public safety.

The NPRM includes language that would allow the FAA to impose requirements that are not codified in statute or regulation and have not been published for review and comment nor subject to a cost-benefit analysis. Such requirements, policies, and practices could be inequitably imposed on a singular licensee, and presumably differently on other licensees which may be developing similar new technology or operational approaches. As written, there is nothing that appears to limit the scope or applicability. FAA proposes the following:

"450.177 (b) FAA unique policy, requirement, or practice. The FAA may identify and impose a unique policy, requirement, or practice as needed to protect the public health and safety, safety of property, and the national security and foreign policy interests of the United States."²⁰

This is a significant and undefined expansion of FAA authority to impose, outside of rulemaking, a previously unknown requirement on an operator, who may otherwise have met established performance criteria, risk criteria, and safety regulations.

²⁰ NPRM, 15441

FAA's existing regulations allow the imposition of requirements beyond those codified in the regulations, but limits the application of "a unique safety policy, requirement, or practice" to those "needed to protect the public."²¹ The NPRM expands the considerations which may, in FAA's judgment, require imposition of a unique requirement. These considerations go beyond public safety to include safety of property, national security, and foreign policy interests of the United States. In its preamble, FAA cites the following rationale for the new rule:

"As the space transportation industry continues to grow, advances in technology and implementation of innovations by launch and reentry operators will likely introduce new and unforeseen safety challenges. These unique challenges will require FAA officials and operators to collaborate on a case-by-case basis to identify and mitigate those unique hazards to public health and safety, safety of property, and the national security and foreign policy interests of the United States not specifically addressed by proposed part 450."²²

CSF notes that nothing in the proposed rule requires FAA to collaborate with an operator, or with industry, before determining a unique policy, rule, or practice is required in its judgment. We are concerned that as written, the expanded regulatory uncertainty in proposed § 450.177, will discourage the commercial spaceflight industry from pursuing advances in technology and implementation of innovations that could greatly benefit U.S. leadership. It could have a substantial adverse impact on current commercial operators, who are developing and deploying new technologies and operational innovations, as well as substantially impede and act as a barrier to entry for small entity operators in their efforts to innovate new systems.

CSF believes FAA must fully readdress this expanded regulatory approach in § 450.177 with the commercial spaceflight stakeholders, and give full consideration as required by the Regulatory Flexibility Act (Pub. L. 96-354) for the impact of regulatory uncertainty on providers currently developing systems today, and those who will be considering doing so in the future.

The FAA's application process and timeframes should be revised to increase flexibility.

FAA has long told applicants of internal FAA timelines that serve as goals for their consideration of license applications. CSF recommends, first and foremost, that FAA acknowledge some of these timelines in an AC. Applicants carry program risk without insight into these timeframes. Applicants should not be forced to submit information into a black hole—particularly applications for modification or continuing accuracy submissions for which there are no current timeframes identified in the regulations. Applicants should have some idea as to how FAA is processing the information and when they can expect a response as to the sufficiency of the submission or a status of FAA's work to process the information to a conclusion. CSF's overarching comment for this entire topic is that FAA issue an AC to capture the time frames discussed.

²¹ 14 CFR § 417.127

²² See preamble Pg. 15374, Federal Register, Vol. 84, No. 72 discussion of Unique Safety Policies, Requirements, and Practices

- *Incremental Review* – In response to FAA’s request for comment on incremental application processing and the statutory timeframe, we interpret the 180-day statutory requirement to mean that the sum total of all increment reviews added up must not exceed 180 days. So, for example, an applicant could submit those increments spread out over a 3 year period, but the total time that FAA spends considering the increments in total must not be more than 180 days. CSF agrees with establishing what the timeline for incremental submissions will be in preapplication consultation. However, CSF recommends that FAA capture in an advisory circular the following maximum goal review time frames for the sections that FAA acknowledges can be included in an incremental review:
 - a. Policy Approval - 60 days
 - b. Payload Review - 30 days
 - c. Safety Approval - 60 days
 - d. Environmental - 5 days to confirm the process required by the National Environmental Protection Act (NEPA) is satisfied. The FAA’s review of an application is to verify that the applicant has fulfilled applicable environmental statutes and regulations. Our understanding is that FAA could probably conduct this review in a matter of days.
 - e. Financial Responsibility - 15 days; this review involves verifying an applicant or licensee has fulfilled the insurance requirements and could likely be conducted in less than 1 week. We acknowledge verification of evidence of other financial responsibility could take longer. This can be mitigated by FAA providing guidance or an AC that addresses the type of information that a licensee will need to submit to satisfy FAA review under § 440.9(f).

CSF also acknowledges FAA’s ability under § 413.15(b) to toll consideration of each increment independently of the other increments being considered. For example, the Safety Approval increment above could be tolled pending additional submission or clarification from the applicant (so, the 60 day period above would be tolled) while FAA continues considering any other increment that had been submitted. The industry’s primary concern with the current lack of understanding of time frames is transparency and the ability to reduce program and operational risks associated with FAA licensing. CSF has no issue with FAA using tolling as long as an applicant understands what the deficiency is and what can be submitted to correct the deficiency. CSF further offers that if an increment is denied, such denial should be treated in accordance with § 413.21, which CSF acknowledges allows FAA to extend the 180-day statutory period by up to an additional 60 days to consider a revised application.

- *Alternative timeframes (current and proposed 14 CFR §§ 404.15,²³ 413.11-17)* – NPRM § 404.15 allows an operator to propose different timeframes for certain regulatory sections. CSF first appreciates FAA’s efforts to streamline some of the timeframes in current regulations and to increase flexibility in the processing of

²³ We note that in at least two places on page 15367 FAA incorrectly references a proposed § 450.15 (there is no such section) instead of proposed § 404.15.

applications. CSF agrees with the approach of proposed § 404.15 with one important change. Proposed §404.15(b)(1) requires that the request to change a timeframe be submitted no later than the specific timeframe identified in the regulation. Operators have not been able to meet this type of requirement in the current regulations. CSF disagrees with this approach and requests that FAA remove any requirement to submit such a request in a specific time frame other than “as soon as the operator understands that a different time frame is necessary.”

For example, operators currently under §§ 415.55, 431.53, 431.79 and under proposed § 450.213 are required to notify FAA of payload details 60 days in advance of launch/reentry. Operators often cannot meet that time frame due to changes in manifests for passive or minor payloads that occur inside of 60 days before flight. Proposed § 404.15 would not allow an operator to request that the timeframe for payload notification be changed unless it knew more than 60 days in advance of flight that the manifest was going to change. The operator often does not know the manifest is going to change until inside of 60 days, so the baseline proposal would not allow an operator to request a different timeframe or therefore update the manifest inside of 60 days before flight. This proposal maintains the rigidity of the current regulations when both industry and FAA know that the current rules are unaccommodating and result in waiver requests to the requirements on timing of waiver requests. Those waiver requests would continue in the situation above as proposed § 404.15 provides no relief for this situation. CSF requests that FAA allow proposed § 404.15 to actually be flexible and prevent waiver requests that both industry and FAA deal with today.

- *Filing a petition for waiver § 404.5(a)* - remove the baseline requirement for the waiver request to be submitted 60 days in advance of the need date. We acknowledge that FAA included flexibility in the proposed rule by allowing “unless otherwise agreed to by the administrator,” however, operators consistently have issues meeting this requirement, resulting in an additional waiver request to the requirement to submit a waiver request 60 days in advance of the need date. We again request that FAA use instead, “as soon as the operator understands that a waiver is necessary.”
- *§ 450.169(f)(1)* - The timeframe associated with this submission should be 7 days. The proposed 15 days conflicts with the current processes at Federal Ranges which allows for submissions around L-10 to L-7 days. That has proven to be adequate time to produce screening results by L-6 hours.
- *§ 450.169(f)(2)* - The L-6 hour timeline to obtain final results is inconsistent with the current delivery of final collision avoidance data (COLA). Currently, the Federal entity performing COLA screenings delivers the final data at L-3 hours. We recommend adding a clause to this section (or to Appendix A) that allows trajectory data delivery timelines as agreed upon between the launch operator and the entity performing the screening.
- *Amendment or Modification to an existing license* – FAA routinely uses the terms “amendment” and “modification” to refer to submissions to change existing licenses or permits. CSF requests that FAA clarify what these terms mean and to which section of Part 413 the terms apply. “Amendment” seems to apply to §

413.17(b), and if that is correct, then FAA should update § 413.17(b) to reflect that applications for amendment can be submitted after a license is issued (and not just before a license is issued) to change the terms of the license. This seems to be a current practice as FAA routinely amends issued licenses. The term “modification” is less clear and currently is only used in § 413.23. It seems that FAA may use this term to refer to a license being “modified” by a continuing accuracy submission, in which case, FAA could update section 413.17(a) to clarify that FAA will agree to a “modification” to an existing license when it accepts and approves a continuing accuracy submission. Regardless, CSF requests that FAA clarify its use of these terms in an AC.

- *Processing timeframes, Part 413* – CSF recommends that FAA publish the timeframes associated with the proposed Part 413 in an AC. Although an initial license application has a complete enough review under current § 413.11, and a 120/90 day feedback requirement under current § 413.15(c), one of the biggest aspects of uncertainty associated with an active license is the timeframe associated with FAA’s processing of continuing accuracy and modification submissions. It is possible that a license, once issued, will go through years of renewals, modifications, and continuing accuracy submissions, which often times results in an operator never again requesting a new license for an existing family of vehicles. There currently are no time frames associated with these on-going submissions, leading to operators carrying risks in their program that can only be mitigated by continued requests to FAA for status updates, which FAA has no obligation to respond to. To improve transparency between FAA and an applicant or operator, CSF recommends the following changes to the current regulations, or documenting the following practices in an AC. Any submission (e.g., an initial license application submission, any continuing accuracy or license modification request) should follow the same review process:

- *Complete Enough* – CSF recommends that current § 413.11 be expanded to apply to any application submission (initial, continuing accuracy, or modification). CSF recommends revising § 413.11 as follows:

“The FAA will initially screen any application submission—whether an initial submission, a continuing accuracy submission, or an amendment request—to determine whether it is complete enough for the FAA to start its review. After completing the initial screening, the FAA will notify the applicant in writing of one of the following:”

The FAA should provide clarification in an AC with a checklist for how the FAA makes its “complete enough” determination based on the deliverables required by proposed Part 450. That checklist should be comprised of the regulatory sections that require specific submission (e.g., proposed § 450.103(e) includes application requirements that would be included in the Part 450 application requirement checklist). FAA aims to issue complete enough determinations under § 413.11 within 10 days of receipt of the submission.

- *30 day initial review* – CSF recommends that the FAA include in an AC on time frames, that it aims to provide substantive response (for example, identify any showstoppers or shortcomings in the submission) within 30 days of

receipt of the submission. This 30 day review would constitute an initial review of the substance of the submission by every AST team involved in the review.

- *2 week status updates* - CSF recommends that the FAA include in an advisory circular on time frames, that FAA aims to provide substantive feedback to the applicant at least once every 2 weeks after the 30 day review is issued to provide a status to the applicant of each FAA team's review of their relevant sections.

Certain proposed definitions require revision for clarity.

Critical Asset

CSF does not agree with FAA's new regulatory approach and risk analysis requirements for critical asset protection, or FAA's new defined term of "Critical Asset" as proposed in § 401.5. This new regulatory burden requires a separate risk analysis for each property asset designated as "critical" to national interests.

Assets considered critical to national security or national priority missions are already protected by current practice at NASA and USAF operated Federal ranges.²⁴ As pointed out by FAA in the NPRM, on page 15311. The FAA's proposed rule would appear to duplicate and overlap these current practices, not eliminate them. FAA states NASA uses the same risk criterion (1×10^{-3}) for designated assets and that the USAF adopted the NASA standard, sometimes using a more stringent criterion for national security payloads and related infrastructure. With no insight into the interaction between the proposed Part 450 and existing requirements by NASA and the USAF, industry must conclude that it will again be answering to multiple authorities, with an operator having to prove compliance with all three sets of requirements – FAA, USAF, and NASA.

Proposed § 450.101 also establishes a new FAA regulation of critical assets -- not currently included in FAA's rules -- to all licensed launches and reentries wherever they occur. FAA proposes to regulate the risk of "loss of functionality" to assets considered critical for the "national interest" at all U.S. launch and reentry sites, whether Federal, state/local, or privately operated.

This new regulation and its broad application to all licensed activities nationwide does not appear consistent with the FAA's characterization of the proposed rule as a "deregulatory action" under Executive Order 13771. The cost burden to industry for compliance does not appear to be included as a provision category/impact in the "Summary of Total 5-year Quantified Savings, Costs, and Net Impacts"²⁵ and would seem to be at this point a significant unquantified cost to industry, especially to small entity operators, due to its unbounded scope of affected property which must be analyzed for compliance with § 450.101. There are additional specific analysis requirements related to critical assets, including requirements for a preliminary safety assessment (§ 450.105), hazard control strategies (§ 450.107), and debris risk analysis (§ 450.135). FAA has not addressed the cost of compliance with this new requirement as a paperwork and other data collection

²⁴ NPRM, 15311.

²⁵ NPRM, 15406.

burden, as it is required to do under 44 U.S.C. §3507(d) reviewed in the NPRM on Pg. 15409 under Section IV, Regulatory Notices and Analyses.

The NPRM should be amended to provide clarity on what “loss of functionality” means. The only example offered is a launch pad damaged in an accident that becomes unavailable until repaired. CSF requests clarity on the following aspects of this new regulatory requirement:

- Is infrastructure “critical” that is needed to support full functionality of an asset deemed critical to the national interest?
- What is the standard for determining when an asset’s function has been lost?
- Does it matter if that function can be restored in a timely manner or met with an alternative asset?
- Does the FAA or the asset owner determine what assets will be designated “critical” for purposes of compliance, and what circumstances could result in that asset’s “loss of functionality”²⁶ that must be addressed in the risk analysis for a specific asset?
- How does FAA propose to manage proprietary and national security concerns among operators and property owners who must share this information so that operators can conduct this analysis?

The FAA should fully consider the risk that if NASA or the DOD does not agree with FAA’s implementation of this proposed rule (e.g., the designation of critical assets or the conditions resulting in unacceptable loss of functionality), then operators will remain subject to NASA or DOD imposition of their own rules and analysis requirements on Federal ranges or Federally-controlled property where commercial launches occur. The FAA should consider questions such as: How does FAA propose to address this duplication of authority? For operators at sites that are not Federal ranges, will other USG agencies be imposing requirements on operators or will they come through FAA only?

Based on the NPRM, CSF concludes that operators on non-Federal sites, either FAA-licensed launch sites or privately-operated launch sites owned by a single user, will be subject to a determination by FAA or a Federal agency that an asset considered critical to the national interest is located within that site, in proximity to that site, or anywhere under the flight trajectory of a vehicle launched from that site. There is no bounding in FAA’s proposal to the number or location of property assets that an operator may have to perform a discrete risk analysis on, or the conditions that may represent a loss of functionality severe enough to impact the national interest. That raises the following questions:

- How and when does a definitive list of “critical assets” get determined by FAA and transmitted to an operator for analysis?

²⁶ NPRM, 15306.

- If the asset(s) in question are designated due to national security, how is it reasonable to expect an operator will have adequate access to the site and position information to perform the proposed analysis?
- What are the acceptable methods of verifying that the risk of a licensed launch or reentry does not violate the prescribed risk criteria for “each critical asset” on that list?

Current practice on Federal ranges allow an operator to waive this requirement for their own facilities and allows a waiver among neighboring operators or by the site authority. The FAA should clarify how its approach will allow for waivers by an operator for their own facilities that may be deemed critical assets, or provide such flexibility to neighboring operators and the local site authority. That this new requirement, as written, will generate a need for frequent waivers to be processed is certain, and industry should know how FAA will plan to address that. FAA should estimate in its cost analysis of the new rule the cost to industry and the FAA to process such waivers.

CSF recommends that the FAA revise its approach to “critical assets” as follows:

- Explain how imposing a new critical asset protection criterion proposed in §450.101 and the definition of “critical asset” in the amended § 401.5 will not be a duplication of existing NASA and USAF asset protection practices and risk criteria. Given the interagency deliberations discussed by FAA in the NPRM preamble, explain how industry will not be subject to potentially conflicting rules and analysis requirements by multiple Federal authorities – FAA, NASA, and USAF. Fully engage industry, not just other Federal authorities, in a discussion on this topic.

- Consider an alternative definition of “critical asset” in § 401.5 to read:

“Critical asset means a U.S. Government asset that is essential to the national interests of the United States as determined by the Secretary of Defense or the Administrator of NASA. Critical assets include only those U.S. Government assets necessary to maintain the national defense or capability for national priority missions; and are property, facilities, or infrastructure, located on Federal launch or reentry property under the jurisdiction of the Secretary of Defense or NASA Administrator, or other property meeting the criteria above, that is owned by the U.S. Government.”

- Amend § 401.5 to include a definition of “Loss of Functionality” that would inform the analyses required to satisfy the risk criterion in § 450.101. CSF recommends the following:

“Loss of functionality of an asset designated critical by the Secretary of Defense or Administrator of NASA means the asset has been (a) rendered

unable to support a specific mission or program deemed critical to the national interest; (b) the loss of function will preclude the assurance of a time-critical mission or program unless promptly restored; (c) the asset's function cannot be restored by an accelerated recovery strategy or replaced by an alternate means of mission/program execution."

- Publish in a SNPRM a clearer rationale and justification for the need to duplicate existing practices at Federal ranges, explaining the path to eliminating duplicative, overlapping, or conflicting requirements as directed by the 2019 NDAA and SPD-2.²⁷ Publish new definitions as revised, and publish an AC that not only provides acceptable means for analyzing the risk to critical assets but also describes how the FAA will obtain a definitive list of critical assets subject to the rule, and how FAA will provide to operators the data necessary for their analyses, including what would constitute an unacceptable loss of functionality. Data provided to an operator by the FAA, or an impartial 3rd party, must be the same set of data provided to all operators to ensure a fair and unbiased application of this regulation.
- Industry does not understand how it would carry out an analysis to show compliance with this new risk limit given that the USG holds the information related to location, importance, and functionality of "critical assets." CSF requests that FAA provide detail as to the process that operators from non-Federal launch sites will use to conduct this analysis, and how that process will not result in additional cost and burden to operators.
- Address the need for situations likely to require waivers from this prescriptive criterion for an operator's own designated critical assets, and assets which may be shared or common use infrastructure.

Support of Safety Critical

CSF supports the updated definition of "safety critical" under proposed § 401.5 by striking:

*"Something that is a safety critical item creates a safety hazard or provide protection from a safety hazard."*²⁸

"Safety Critical" assets under the existing definition would require an operator to include a system or subsystem component that creates a safety hazard in a hazard analysis. It is our understanding that the updated definition under proposed § 401.5 not only clarifies the components under the jurisdiction of the required analysis, but also eliminates the need to report a component that could conceivably create a hazard, therefore leaving the reporting requirement to include only that which ensures the proper safety and operation of the system. We support the streamlining of this definition.

²⁷ 2019 NDAA; SPD-2

²⁸ NPRM, 15414.

Proposed Alternative Definition of “Public”

CSF urges FAA to focus its regulatory resources on ensuring the safety of the general public population that is uninvolved in any way with commercial space transportation activities, generally those people who reside and work outside the controlled areas of a launch or reentry site. These sites include Federal, state-local, and privately-operated sites that may host multiple launch and reentry operators or development/test activities. As the ARC observed, those site operators – whether licensed or not – have roles and responsibilities for managing the safety of their resident workforces and visitors, including the establishment and enforcement of controls to limit and mitigate risks to authorized personnel which may be required to perform essential tasks within a hazard area for a particular licensed or permitted launch or reentry.

CSF proposes that FAA exclude Neighboring Operations Personnel from the definition of “public” because they have an essential on-going requirement to conduct neighboring space transportation activities. In addition, the definition of “Public” should exclude persons who have an involvement in the licensed activity such as invited guests of the operator.

FAA’s current rules do not include a definition of “Public.” FAA and industry have had to derive the definition of “Public” from FAA’s definition of “Public Safety” which is included in the current rules. That same derivation resulted in FAA’s proposed definition of “Public” in the NPRM. This definition has proved historically problematic in that it can be difficult to determine how “involved” a person needs to be in the licensed activity to not be considered a member of the “Public.” When asked specifically for interpretation on a case by case basis (because little published guidance exists), FAA typically has required that a person be required for, and directly involved in, processing or operating the vehicle or a payload in order to be considered involved in the launch or reentry activity (“turning wrenches” is a phrase that appears regularly in these conversations). This interpretation has not allowed for customers or other stakeholders with legitimate interest in the launch or reentry activity to be on-site unless their presence is required to actually carry out the launch or reentry activity. Customers with payloads on board could arguably be “involved in supporting the launch or reentry” even if they are not physically turning wrenches on their payloads to prepare it for flight. Families of astronauts on board are arguably “involved in supporting the launch or reentry” even though they are not on board the flight. There are numerous reasons why an operator might seek approval for non-launch essential personnel to be on-site including business development, astronaut experience, non-advocate oversight (e.g., official-purpose observers representing NTSB, other USG agencies, independent operations reviewers).

The individual and collective risk criteria for public was developed to limit the risk to people not aware of the hazards associated with the operation because they have no connection to or involvement in the operations. This results in an inconsistency in logic in terms of those that are briefed on the risks and hazards and choose to participate in the operation at some level. Labeling those people as “public” ignores the policy behind the risk criteria. They are informed of the risks and they have chosen to participate. The operator has secured insurance to cover the risks these people face as required by the statute: Why should such individuals be treated the same as those who have no knowledge of, interest in, or connection to the activity?

Maintaining a definition of public that does not distinguish between those who have been briefed (e.g., through a range safety briefing and site operator safety procedures) and who have chosen to participate (e.g., through waiving claims against other involved parties, or by engaging in launch services contracts and paying for launch services), and those who have not will continue to be problematic as commercial spaceflight operations further develop and increase in frequency. The definition as written is akin to not allowing people to enter an airport unless they are a ticketed passenger. This is shortsighted and is not future-proof.

CSF proposes evolving the definition of public to allow for a risk threshold for those that have been briefed and chosen to participate to the same level as neighboring operations personnel, leveraging the same rationale used for allowing neighboring operations personnel to remain on-site. There is precedent for this approach in historic NASA operations.

CSF recommends FAA consider adopting the following definition:

Public means, for a particular licensed or permitted launch or reentry, people and property that are not involved in the launch or reentry activity and includes those people and property that may be located within the launch or reentry site, such as visitors, individuals providing goods or services not related to launch or reentry processing or flight, and any other operator and its personnel, except for individuals designated as Neighboring Operations Personnel and invited guests of the launch or reentry operator.

By adopting this definition of “public”, we believe the FAA can, without compromise to its prescribed risk criteria intended to protect the public safety, reduce regulatory burden on both the industry and the FAA, as well as further its mission to “encourage, facilitate, and promote”²⁹ this nation’s commercial space transportation industry.

Neighboring Operations Personnel

CSF does not agree with FAA’s proposal regarding Neighboring Operations Personnel, or FAA’s new defined term of “Neighboring Operations Personnel” as proposed in § 401.5. The primary purpose for addressing a change in the current rules is to recognize the increasing need for industry to conduct concurrent launch and reentry activities in proximity to one another. While not involved in each other’s specific licensed launch or reentry, industry operators will be separately pursuing their respective activities, often under separate FAA licenses for similar types of commercial space transportation operations in competition with one another.

Neighboring operations to a licensed activity may also include Government or private operations not subject to FAA licensing but none-the-less essential for a Government launch program or a private test program not requiring an FAA license. At Federal, state-local, and private spaceport sites hosting multiple users, an evolving industry with a rapidly increasing operations tempo shares a confined geography, necessary in order to group hazardous operations into areas that afford safe buffer from general public populations.

²⁹ NPRM, 15296.

An effective approach with limited FAA regulatory involvement is needed to ensure industry growth is enabled to support U.S. leadership in space transportation, while limiting the exposure of neighboring operators to each other's respective hazardous activities. It must allow competing operators to maintain their access to serve their respective customers, with a minimum of disruption and work stoppage. CSF does not believe the FAA approach achieves this goal.

CSF continues to believe, as was also suggested by the ARC, that these neighboring operations are carried out by trained industry personnel who should not be classed as members of the public. It is appropriate to consider such personnel as "third parties" as defined by the CSLCA with respect to a neighboring licensed activity, and to include those who may need to remain within a hazard area in the MPL for purposes of liability and insurance requirements. We believe the FAA has the statutory latitude to classify certain operational personnel as third parties without classifying them as public, since "public" is not defined in statute.

We agree there is a need to manage risk to neighboring operators from the hazardous operations of their neighbor. We concur with the higher risk threshold proposed by FAA. However, we strongly urge FAA to reconsider its regulatory approach, and defer to Federal, state-local, or private site owners/operators the sole determination of which personnel will be considered essential to on-going operations and what hazard mitigation measures will be observed.

Revised rules for neighboring operations personnel should apply also to private sites. These sites control public access and are owned and operated for the exclusive use of one operator. A private operator may have multiple licensed programs, or some developmental or test programs not requiring FAA licenses, which require on-going concurrent activities. Therefore, private sites also need the benefit of revised FAA rules that enable concurrent operations.

A concern exists as to how the data required to perform analysis to prove compliance with the prescribed risk criteria will be obtained and provided to support the licensed operation. Neighboring operators may be competitors unwilling to disclose personnel staffing details, or Government operators of classified activities.

CSF recommends that the definition of Neighboring Operations Personnel in § 401.5 be revised to read as follows:

"Neighboring Operations Personnel means, as determined solely by the Federal or licensed launch or reentry site operator, or private launch or reentry site owner/operator, those non-public third-party personnel located within a launch or reentry site, or an adjacent launch or reentry site, who are not associated with a specific hazardous licensed or permitted operation being performed, but who are authorized to perform safety,

*security, or essential tasks within the hazard areas designated for that operation and are notified of the operation.*³⁰

As an alternative means of allocating risks among licensed operators occupying sites in proximity to one another, we ask the FAA to consider including an adjustment to its calculated MPL insurance requirement for an operator's licensed activity if that operator obtains a waiver of liability and assumption of risk from a neighboring operator for its personnel who are authorized pursuant to this rule to remain within a hazard area, provided that the waiver also covers the U.S. Government.

Propose more details in a SNPRM as to how personnel data, including data considered proprietary or classified, will be used by the FAA to determine MPL and insurance requirements related to NOP, and furnished to a licensee to perform the analysis to comply with the individual and collective risk criteria for NOP.

Launch - § 401.5

CSF agrees with FAA's proposed revision of the § 401.5 definition of "launch." The proposal provides increased flexibility over the repeated waiver requests that result from the current definition of launch. CSF appreciates that the revision reflects industry's long engagement with FAA on this topic.

Scope of a Vehicle Operator License -

- *§ 450.3(b) beginning of launch* – CSF acknowledges the flexibility that FAA has included in this proposal to address concerns previously expressed regarding the beginning of launch (e.g., addition of "Unless a later point is agreed to by the Administrator..."); however, CSF does not agree that the arrival of the vehicle or major components should be the baseline designation in § 450.3(b). The text of the rule should not baseline a system that industry has long highlighted to be broken and require the majority of operators be in a position where they are seeking relief from the base language of the rule. Instead FAA should propose regulatory text that removes the inefficiencies and failures of past rules and propose an improvement. FAA acknowledges issues with this approach in the preamble (e.g., RLVs needing to be "licensed" for their entire lifetimes, unbounded inspection oversight) and then still proposes it as a baseline. CSF disagrees with that approach.

Further, the addition of "or its major components" to the default beginning of launch designation, is more problematic than the "arrival of a payload" that exists in the current rules. Some Launch sites are increasingly co-located with manufacturing, production, refurbishment and test facilities (e.g., vehicle manufacturing facilities, engine test facilities). Often, launch activities are not even the dominant activities at the site. The baseline designation would raise the question as to whether test activities conducted on flight hardware, or manufacturing activities that take place on vehicles (activities that more traditionally have not occurred at launch sites) fall under the licensing authority of FAA as defined in §450.3(b)(1).

³⁰ We recommend changing the term "critical" to "essential" in the new definition

Finally, FAA did not address the overlapping jurisdiction of FAA and other Federal and state agencies (OSHA, EPA, ATF, their state & local equivalents) for hazardous ground operations. In the interests of removing duplicative authorities, FAA should acknowledge when other agencies have jurisdiction over activities and not duplicate that oversight.

Regarding FAA's jurisdiction over launch activities at a non-U.S. launch site, proposed §450.3(b)(2) could be problematic for captive carry technologies who must comply with the oversight of foreign aviation authorities. We therefore recommend removing the reference to "the first movement that initiates flight" and keep the focus on ignition of the launch vehicle in this case.

CSF proposes to revise proposed 450.3(b) as follows:

(b) A vehicle operator license authorizes launch, which includes the flight of a launch vehicle and pre- and post-flight ground operations as follows:

(1) As agreed to by the Administrator, Launch begins when hazardous preflight ground operations commence at a U.S. launch site that pose a threat to the public and no other Federal or state regulatory agency has jurisdiction over those activities.

(2) At a non-U.S. launch site, launch begins at ignition.

- § 450.3(b)(3) -- CSF also requests a clarification to the language in proposed §450.3(b)(3) regarding suborbital vehicles. Please explain the distinction of suborbital vehicles that do not include a reentry; if a suborbital vehicle does not reenter, what happens to it? The distinction is not clear from the preamble or the proposed regulatory text.
- § 450.3(b)(3) *end of launch* – Taking the term "vehicle," as clarified,³¹ §450.3(b)(3)(i) addresses end of launch for a launch vehicle without a reentry of that launch vehicle. In the case of any orbital launcher (an ELV or an RLV) something returns: boosters land or are disposed, upper stages are disposed. So, we do not think the designation of with or without a reentry of the vehicle is relevant. We also do not think it necessary to distinguish between orbital and suborbital vehicles. CSF proposes that we only need one designation for end of launch. We also recommend acknowledging that this should be worked out during pre-application consultation and defined in the license as is often the case today.

In addition, for hybrid vehicles, launch is defined to end when the re-entry vehicle is returned to a safe state on the ground but does not mention recovery of the carrier aircraft, if applicable.

CSF proposes the following revisions to § 450.3(b)(3):

(3) As agreed to by the Administrator, Launch ends when any of the following events occur: after the licensee's last exercise of control over its

³¹ FAA clarified in its July 16, 2019, docket submission that the terms "vehicle" and "site" in § 450.3(b)(3)(i) and (b)(3)(ii) refer to "launch vehicle" and "launch site" respectively.

launch vehicle on orbit, after launch vehicle stage impact on Earth, after activities necessary to return the launch vehicle or stage to a safe condition on the ground after landing, or after activities necessary to return the launch site to a safe condition, whichever occurs later.

The process for complying with FAA's Part 440 requirements should be streamlined

Insurance

The NPRM includes a minor change to 14 CFR § 440.15 to allow a request under revised § 404.15 to regarding the timeframe for submitting the required reciprocal waiver of claims and evidence of insurance. There are a number of streamlining reforms that would benefit Part 440 that were not included in the NPRM. We petition the FAA to engage in reforming Part 440 in the near term.

Unfortunately, the change to § 440.15 does not reduce the burden of compliance in the most impactful and efficient manner. The current approach to meeting the insurance requirements of § 440.15 involves submitting mission-specific certifications to the FAA as evidence of insurance no less than 30 days prior to the start of each licensed or permitted activity (60 days when showing evidence of financial responsibility), even when multiple licensed or permitted activities are covered by the same insurance policy. This results in a paperwork exercise that carries costs for the FAA, the licensee, and the insurance community. As the pace of launch and reentry operations increase over the next decade, this inefficiency and related cost will be amplified.

The requirements for a licensee's insurance coverage are dictated in §§ 440.9, 440.11, 440.12, and 440.13, which must be reflected in the policy or policies that the licensee carries. The requirements for demonstrating compliance under § 440.15 should be streamlined beyond the modification in the NPRM.

CSF recommends that § 440.15 (c) be modified so that, when multiple licensed or permitted activities are covered by one insurance policy, the operator is only required to submit the policy or policies that demonstrate compliance with § 440.9 once, which will be kept on record by the FAA along with all the other application documents supporting the activities under the license or permit and applied against all covered activities. A new submission of evidence of insurance should be required only if and when the terms of the original evidence of insurance are changed. We recommend revising § 440.15 (c)(1)(ii) to read as follows:

(ii) Filing with the FAA one or more certifications evidencing an insurance policy in compliance with this Part by one or more insurers under a currently effective and properly endorsed policy or policies, applicable to the activities covered by the license or permit, and specifying any policy exclusions;

This recommended revision will result in streamlining a process that is currently burdensome for operators, the insurance industry and the FAA.

Waiver of claims

CSF recommends that the FAA update the compliance requirements in 14 CFR § 440.15 (iv) (v) and (vi) to allow the use of electronic signatures. The FAA should eliminate the requirement for original signatures by every party to the waiver of claims required by 14 CFR § 440.17 and the Part 440 Appendices.

The FAA's environmental review process should be streamlined.

CSF reviewed the FAA's proposed consolidation of the environmental review requirements for a vehicle operator license, proposed as § 450.47. The FAA also proposes to amend the license requirements for a Launch Site or Reentry Site (Parts 420 and 433) to include the same new regulations. We understand that the general environmental process for compliance with NEPA is unchanged by the proposal, but there are new requirements that could be significant in the responsibilities of applicants: the language of § 450.47 does not mirror the language in FAA order 1050.1F.

The proposed rule would mandate the applicant prepare an Environmental Assessment with FAA oversight; assume financial responsibility for preparation of an Environmental Impact Statement when requested by the FAA; or submit a written re-evaluation of a previously submitted EA or EIS. An applicant may seek a Categorical Exclusion with supporting rationale. An application must include one of these. The FAA should explain why this change in language is required from the present wording of § 415.201 and § 415.203. The FAA does not define what it means by "under FAA oversight" in lieu of present requirements in 1050.1F that requires FAA approval of an applicant-prepared EA. The new regulation to require an applicant to provide a written re-evaluation upon FAA's request of a previously submitted EA or EIS is likewise unclear for its cost and schedule impacts on industry. FAA does not describe the situations or frequency with which it expects to make such requests, or whether it intends to use a written re-evaluation to determine whether a supplemental EA or EIS is required.

CSF recognizes the obligation of FAA to meet its statutory requirements for NEPA, and an applicant's responsibility to provide the necessary information to support FAA's determination. However, CSF is concerned that the proposed rule as written, without clearer language and a completed AC, suggests a potentially significant increased burden for launch/reentry operators as well as launch/reentry site operators. We do not believe these added cost burdens and impacts have been analyzed by FAA in its regulatory assessment, or its determination of potential impacts on small entities.

We are concerned the FAA proposal does not include streamlining efforts to adopt, to the greatest extent possible, the NEPA documentation of other Federal agencies or licensed site operators. Such previous work, often performed with FAA as a cooperating agency, may have assessed an envelope of conditions and operations that could include the applicant's activities. FAA should do all it can to minimize replication of previous NEPA analysis by the applicant or the host spaceport, and to incorporate into the new rule alternative methods of compliance.

We note that applicants that wish to employ the new licensing option for including multiple sites under one license may be especially vulnerable to time and cost uncertainty resulting from these environmental review requirements, and the overall NEPA process.

CSF also encourages the FAA to request appropriations to fund regional or area environmental assessments, and/or assist state and local sites in performing enveloping assessments that would streamline the licensing process for operators at those sites.

The Conditional Expected Casualty (CEc) requirement lacks key detail.

In researching the CEC calculation, we were not able to locate any publicly available details of methodology or background on the calculation and its merits in determining the design and reliability requirements of a flight safety system. Furthermore, to CSF's knowledge, CEC is still a topic of discussion within the Range Commanders Council (RCC) and is not a widely accepted practice nor has it been subjected to rigorous testing against launch and reentry vehicles. Given the lack of publicly available information about CEC, we are worried that basing prescriptive requirements on this methodology could have widespread, negative impacts on the commercial space industry.

CEC appears to be an approach that is still rooted in theory verses ready for practice. We do not recommend that applicants be precluded from making a safety case to justify a certain level of rigor on a Flight Safety System, and we also do not recommend that CEC be directly referenced in the regulation. We suggest that the FAA consider developing the regulation in a way that is performance based, by which operators must meet the EC defined in §450.101(a) and (b), and then CEC is an acceptable means of compliance to determine what type of flight abort to employ. As written currently, CEC is the only way to define what type of flight safety system to implement. The FAA should place the CEC approach and methodology in an AC while still maintaining a performance based requirement such that applicants could choose to use CEC as a means of defining what type of FSS they implement or they could provide their own innovative approaches to determining what type of flight abort to implement as part of licensing.

As currently written, §§ 450.101(c) and 450.145 are extremely prescriptive and don't give an operator any flexibility beyond using CEC to define the type of flight safety system to implement. By utilizing an AC to document CEC and the resulting criteria for determining the need and reliability for an FSS, this would shift the referenced regulations to performance based, leaving the option open to vehicle providers to provide rationale for using a less rigorous FSS, or an entirely different means of flight abort. Overall, CEC has been applied in too prescriptive of a fashion across several areas where it does not add benefit to public safety. It should be as simple as requiring the operator to make a safety case (as recommended in the ARC report) and using the result of that process to evaluate the reliability of the FSS needed; ideally, there would be more variability in those reliabilities rather than what is allotted in the current draft rules.

“Proposed § 450.101(c) would set the flight abort criteria for both launch and reentry. It represents the most significant change to public safety criteria in this proposed rule. It would require that an operator use flight abort as a hazard control strategy if the consequence of any reasonably foreseeable vehicle response mode, in any one-second period of flight, is greater than 1×10^{-3} conditional expected casualties (CE_c) for uncontrolled areas. CE_c is the consequence, measured in terms of EC, without regard to the probability

*of failure, and will be discussed in the Consequence Protection Criteria for Flight Abort and Flight Safety System.*³²

While CSF appreciates the intent of CE_c in establishing clear criteria for when a flight safety system is required and what level of reliability it should demonstrate to mitigate high consequence, low likelihood events, CSF anticipates numerous unintended consequences should this requirement be adopted as written. Some of these examples are included below:

- A CE_c analysis is computationally intensive and will be challenging for both small scale operators and orbital launch operators. Complicating the issue is the fact that approved risk analysis tools, and input data such as population data are not readily available. Without standard methods, tools, and inputs, different operators may come to very different conclusions in their efforts to quantify CE_c . The potential result is for two equally hazardous vehicles (normalizing for public exposure) requiring flight safety systems of different reliabilities. Another potential result is for two vehicles with very different hazard profiles, both requiring a highly reliable flight safety system.
- Meeting a CE_c value of lower than $1E-03$ or even $1E-02$ may be difficult for numerous operators because CE_c does not account for vehicle reliability or testing and the fact that even 1 second of dwell time over a population may exceed the conditional criteria. This may result in a substantial increase in cost to operators that are currently able to show compliance with individual and collective risk requirements.
- Requiring a highly reliable flight safety system does not improve safety for orbital launch vehicle overflight or reentry vehicle overflight given that vehicle hazards cannot be contained during these flight phases. Moreover, even for vehicles that implement a highly reliable FSS (.999/95%), it is still possible to fall into the highest risk bin ($CE_c > 1E-03$) and not improve a risk posture measured by CE_c .
- Conditional risk does not put space vehicles on path to demonstrated reliability. The vision for this industry is for launch and reentry to become highly routinized. Individual and collective risk requirements give credit for flight history, CE_c does not.
- Little justification is given for the quantitative criteria associated with this requirement, and CSF does not believe FAA has sufficiently evaluated the impact of this new requirement to the industry.

NPRM Page 15312 Note 53 states:

The waiver rationale also cited an analysis of 30 years of empirical evidence provided by the NTSB that showed that the public safety consequences associated with general aviation accidents is 1×10^{-2} expected fatalities. The FAA's analysis demonstrated that the consequence of events that could produce debris outside of the impact limit lines was consistent with the

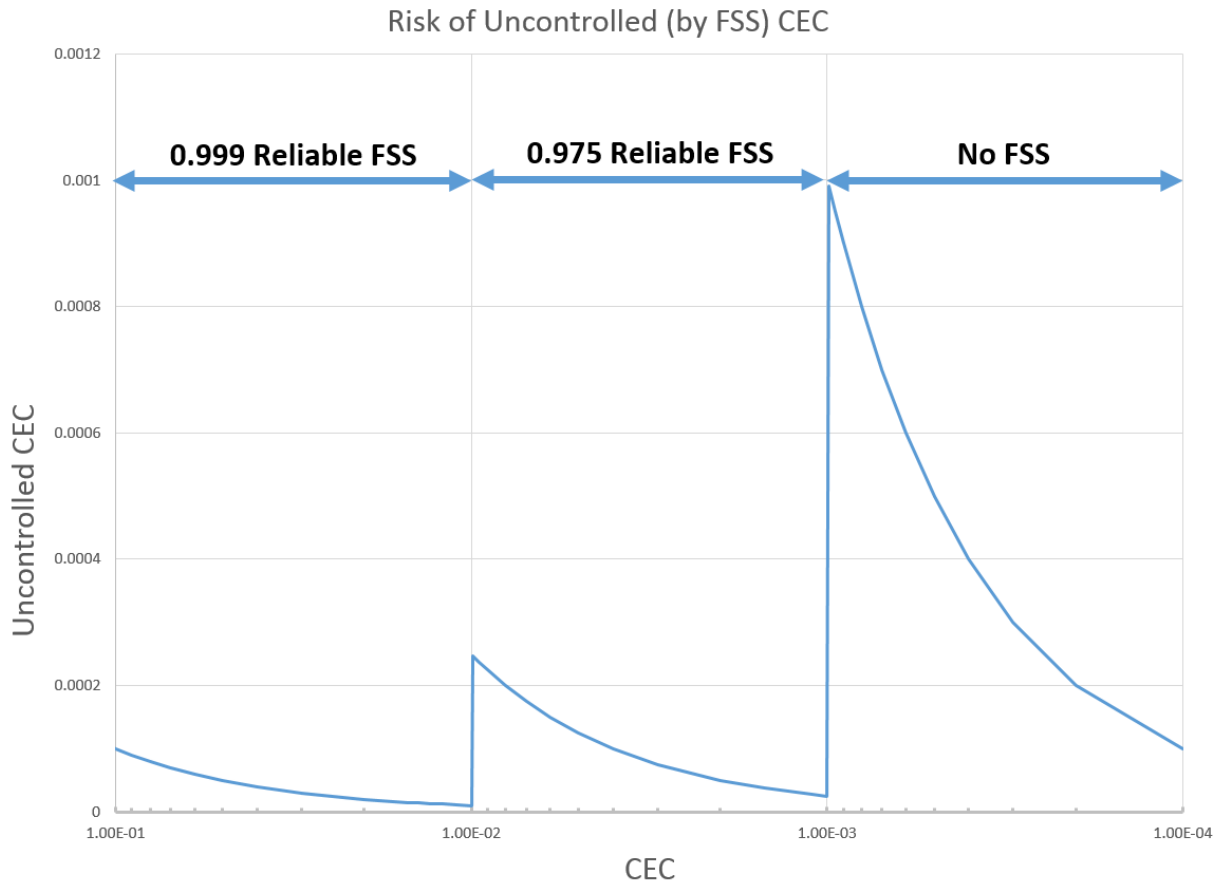
³² NPRM, 15307.

*threshold of $1 \times 10^{-2} CE_C$, even with input data corresponding to the worst-case weather conditions.*³³

This rationale is flawed in that it compares general aviation hazards to launch and reentry vehicle hazards, however these operations have different risk profiles and different approaches to mitigation. Launch and reentry vehicles tend to be more massive and contain more propellant than general aviation (GA) vehicles; GA vehicles are common carriers regulated through FAA certification systems, whereas launch and reentry vehicle operations are licensed based on compliance with public safety criteria; it is not an appropriate comparison. FAA cites waivers approving potential impacts of debris with a ballistic coefficient greater than 3 pounds per square foot (psf) beyond impact limit lines based on the conditional risk associated with these impacts being below $1E-02$. Given that these analyses were only performed for operators seeking waivers, the dataset is not of sufficient size to draw conclusions on how this new quantitative requirement would affect the numerous operators that have not sought waivers of this kind. The preamble lacks sufficient justification to hard code this quantitative criteria into a regulation. FAA has proposed the safety case and hazard analysis approach in §§ 450.103-.109, and then not trusted us to use it in this case. Instead, FAA should place its expectations in an AC, and allow an applicant to prove an equivalently safe approach either through an ELOS or Accepted Means of Compliance.

- Finally, by binning the CE_C of a vehicle and then prescribing a fixed reliability requirement for the FSS, the risk of an unmitigated (by FSS) CE_C event is not consistent:
 - The binning requires the same FSS even though the risk varies by an order of magnitude between the extreme values in the bins (triangle slopes in the chart below)
 - The uncontrolled/unmitigated CE_C is not consistent across bins

³³ NPRM, 15312.



For these reasons CSF strongly recommends moving the entire concept of CE_c into an AC in order to provide flexibility in meeting the intent of when an FSS is required to mitigate high consequence low probability events. So, delete § 450.101(c) entirely. At minimum, the quantitative criteria should be moved to an AC and replaced in the regulatory text with qualitative criteria as recommended by the ARC. The ultimate risk criteria applied to commercial space operations should be the Expected Casualty limits in proposed § 450.101(a) and (b), and they should be satisfied through the system safety and hazard analysis process established in other section of the proposed rule.

The burden related to the post-flight data review requirement has been increased.

In the preamble discussing § 450.103(d), the FAA makes the following request:

*The FAA seeks comment on whether proposed § 450.103(d) would change an operator's approach to reviewing post flight data.*³⁴

Proposed § 450.103(d) requires a post-flight data review that is a new requirement not embodied in § 415, 417, 431 or 435. Our recommendation is that § 450.103(d) be deleted as inconsistent with the directive to streamline the regulations.

³⁴ NPRM, 15315.

The FAA rationale is that any added burden is minimal, since industry practice is to review post-flight data for reliability and mission success. However, the proposed requirement extends beyond this industry practice to require the operator to develop and employ a process for evaluating post-flight data to

“ensure consistency between the assumptions used for the preliminary safety assessment, any flight hazard or flight safety analysis, and associated mitigation and control measures.”³⁵

It would further require that the operator “address any anomaly identified” and “resolve inconsistencies prior to the next flight of the vehicle”.³⁶

This requirement extends the industry practice beyond the typical analysis for reliability and mission success, and is therefore a new burden beyond the current industry practice.

It is not clear from the language whether the “process for evaluating post-flight data”³⁷ will be subject to FAA review and approval. If so, this creates an even larger burden on the operator.

As an alternative to deleting § 450.103(d) entirely, the section should be re-written to very narrowly address only post-flight data of safety-critical systems (such as the performance of launch abort or flight termination systems) that are relevant to the FAA's public safety responsibilities. Post-flight analysis of non-safety-critical data, and analysis *for reliability and mission success* (that is, not explicitly for public safety) is outside the responsibility of the FAA.

The Draft Rule adds software requirements that are excessive and may have a negative impact on safety.

CSF disagrees with the prescriptive approach to regulating computing systems captured in proposed § 450.111 and explained in the Preamble (section G and Additional Technical Justification and Rationale), which treats computing systems as needing to meet different or more detailed prescriptive safety requirements than those defined for all other complex systems. FAA's comments in the preamble about the lack of clarity in the current 415/417/431 regulations, and the extensive and time consuming discussion and negotiation that results in the current structure, can be fixed by implementing a performance-based regulation with sufficiently detailed accepted means of compliance in accompanying ACs. While we agree with improving the current day situation, we do not agree that moving the entire industry to prescriptive regulations is the solution. The middle ground, and the one that follows the direction of SPD-2, is to remain with performance based regulations as the high level criteria and then issue detailed ACs that supplement the rules to provide clarity and prevent inefficiencies.

We acknowledge that an applicant would be able to request an ELOS determination under proposed § 450.37 to pursue a different approach to software design and development (thereby avoiding the prescriptive requirements of § 450.111 and implementing a different approach). We disagree with this approach as a baseline.

³⁵ NPRM, 15315

³⁶ *ibid*

³⁷ NPRM, 15427

Adopting prescriptive requirements with an associated laborious ELOS process to avoid them is contrary to the direction of SPD-2 to adopt performance based regulations.

A computing system is just one of many critical subsystems integrated into a larger complex system. All systems and subsystems should be analyzed and controlled for hazards. The fact that a particular system may contain software should be irrelevant to top level performance based safety requirements. For example, all systems need to identify and control hazards. Proposed sections 450.109 and 450.143 provide better performance based requirements for this purpose; it is counterproductive and even dangerous to assume that a set of highly prescriptive regulatory requirements targeted to computing systems will be safer, let alone economical for the FAA or for industry. Performance based requirements allow for many different kinds of technologies that can then be addressed by more detailed guidance in ACs and industry standards.

As currently written, § 450.111 fails to adequately address safety in five fundamental and critical ways:

- The NPRM defines prescriptive requirements in a regulation (at the level of an industry software standard) without providing the necessary and sufficient details found in such standards.

To clarify, we need at least two levels of structure: the higher level performance-based requirement and then the added layer of advisory circulars that reference industry standards to develop the more detailed means of complying with regulations.

We recommend that software hazards be developed through proposed § 450.109(a)(3) - § 450.109(a)(5). Those sections define general (performance based) hazard control strategies that can be applied to any safety critical system, including those containing software. As another example, § 450.143 defines design, test and documentation for any safety critical system, including those containing software. Detailed ACs should be developed for software to define acceptable means of compliance to § 450.109 and § 450.143. This is the appropriate method for solving the inefficiencies and lack of clarity present in the current rule.

Another excellent example is 14 CFR § 25.1301 and 14 CFR § 25.1309, which is the aircraft regulation governing all systems, including software. Advisory Circular AC 20-115C then provides a means of compliance (but not the only means) to these performance-based regulations using industry standard RTCA/DO-178C. This industry standard provides the next tier of performance-based objectives, from which software plans and processes can then be developed and compliance finally demonstrated. At each of these levels alternative means of compliance can be defined either in new ACs or by applicants during the application process. The Aircraft Certification Software and Airborne Electronic Hardware branch of the FAA is currently working on three Performance Based Objectives that would sit between these two layers. These generic system/software/hardware/ database development objectives are Intent (requirement definition & validation), Correctness (verification), and Acceptance (safety acceptance of derived behavior).³⁸

³⁸ AC development for this rulemaking could benefit greatly by discussing this aircraft effort with either Barbara Lindberg (FAA Software and Airborne Electronic Hardware Team Lead) or George Romanski (FAA Chief Scientific & Technical Advisor (CSTA) for Software).

- The prescriptive requirements of proposed § 450.111 are so narrowly scoped that they fail to allow development of specific technologies and techniques, including new technologies.

As written, the NPRM requirements provide too much detail at the regulation level but without providing sufficient guidance that would be found in an industry standard. For example, § 450.111 fails to address object-oriented technology, model-based development, machine learning, tool qualification, load control, formal methods, robust protection and partitioning, integrated modular avionics, and integration with the system process. The level of detail in the regulation discusses specific activities, implying that these are ALL that might be needed to construct a sufficient safety case for computing systems when the truth is that many more activities are typically needed, especially for specific methods and technologies.³⁹

- The methods prescribed by these NPRM requirements are incompatible with proven industry standards such as ISO 26262 and DO-178C.

For example, DO-178C does not require test team independence; and validation is through requirements tracing and identification of derived requirements.

- Proposed § 450.111 eliminates more economical or even safer methods for constructing the safety case.

Instead, it defines one way, and one way only, to prove the software is safe. For example, § 450.111(d)(1) requires full path coverage (which is a lot more than decision coverage and practically impossible for most software). As another example, § 450.111(d)(3) states there must be a software hazard analysis for each autonomous, safety-critical software component. This type of analysis is not required in other safety critical industries (where reliance is placed on system hazard analysis and requirement decomposition).⁴⁰ As another example, the use of product service history (which is relied on for both automotive and aircraft commercial off the shelf (COTS) software) isn't possible with this regulation. As currently written, the NPRM stifles innovation that could lead to safer solutions and greatly increases costs.

- Proposed § 450.111 scales process level of rigor based on level of autonomy, which not only fails to allow for scaling based on other architectural mitigations using fault tree analysis,⁴¹ but also erroneously assumes that human involvement will *always* result in a safer system.

The concept of varying software rigor based on level of autonomy assumes that having a human in the loop is always safer and that providing erroneous data to operators (operator in the loop) will have a less adverse impact on safety than autonomous operation; but these assumptions are not always true. In addition, it is possible to add architectural mitigations, such as pressure relief valves and watchdog monitors that

³⁹ We offer as examples RTCA/DO-331, RTCA/DO-332, and RTCA/DO-333, as well as FAA report DOT/FAA/TC-15/57, "Software Assurance Approaches, Considerations, and Limitations: Final Report".

⁴⁰ See 14 C.F.R. Part 25, for example.

⁴¹ For example, per Aerospace Recommended Practice (ARP) 4754A.

significantly mitigate the effect of software failures. In fact, this is the primary approach used in Nancy Leveson's STAMP process⁴² ARP 4754A provides a much better (and safer) process for scaling software level of rigor based on use of fault trees.

In short, the detailed safety strategy, including guidance for computing systems, should not be located in the regulations, it should be located in Advisory Circulars.

Given the concerns expressed above, CSF recommends the following changes

- Revise preamble discussion in Section G to clarify that the same performance-based requirements (§§ 450.109, 450.143) with which all systems (and subsystems) must comply for identification and mitigation and control of hazards will also apply to software.
- Remove § 450.111 in its entirety.
- The FAA should use ACs developed in cooperation with industry to provide detailed guidance on accepted means of compliance for software development.
- In an AC for software, scale the level or rigor based on the hazard effect and the system architectural mitigations, not based on the level of autonomy, which may have nothing to do with the hazard effect or other hazard controls. Capture mitigations in the hazard analysis where it is possible to reasonably rely on human monitoring and procedures. Use fault tree analysis (FTA) cut sets to inform process scaling. Add controls to mitigate software impact to system hazards and ensure the FTA captures those controls in AND gates; then allow software rigor to be reduced based on those controls.
- Refer to new or existing FAA ACs (e.g., similar to AC 20-115C "software", AC 20-152 "complex electronic hardware", AC 20-153 "aeronautical databases", AC 20-170 "integrated modular avionics", AC 20-174 "system process assurance", etc.) that will provide a detailed means of compliance to performance based regulations for computing systems.

CSF's proposal *improves* efficiency and safety over the proposed NPRM because it a) ensures computing systems are held to safety standards appropriate to their criticality, in alignment with other safety critical systems, b) ensures the regulation focuses not on just a narrow band of prescriptive activities but covers the full scope of safety for computing systems, c) allows innovation and agility in addressing new technologies and new techniques in ACs and the application process through alternative means of compliance with equivalent levels of safety.

The section on software also fails to address design errors and hazard vectors that can be introduced by the system engineering process itself, *especially* for integrated modular avionic.

From ARP 4754A section 4.1.1

⁴² Levenson, Nancy. Safeware: System Safety and Computers (1995) and Engineering a Safer World (2011) in which a hierarchy of system controls to address software risk is discussed.

“Complex systems and integrated aircraft level functions present greater risk of development error (requirements determination and design errors) and undesirable, unintended effects. At the same time it is generally not practical (and may not even be possible) to develop a finite test suite for highly-integrated and complex systems which conclusively demonstrates that there are no residual development errors. Since these errors are generally not deterministic and suitable numerical methods for characterizing them are not available, other qualitative means should be used to establish that the system can satisfy safety objectives. Furthermore, there is no direct correlation between function development assurance level (FDAL) and numerical probabilities. The safety objectives associated with Failure Condition classifications can be satisfied by both the designated function development assurance rigor and by numerical analysis methods (as needed). These two separate methods, in general, are not related and do not complement each other.

In this context, this ARP4754A/ED-79A regards the activities of DO-178B/ED-12B and DO-254/ED-80 as a means to implement the development assurance rigor for the software and electronic hardware items. These software and electronic hardware related processes are no longer considered to be adequate to mitigate aircraft/system errors without a development assurance process from aircraft level down to item level...”

43

For aircraft, the FAA has emphasized the importance of system-level process assurance in personnel training, especially for systems with distributed software architectures. For aircraft, the additional guidance of ARP 4754A and RTCA/DO-297 (and the ACs that reference these standards) fits under 14 CFR §25.1301 and 14 CFR §25.1309, because they are performance based requirements.

The current NPRM does not provide this same structure. By being overly prescriptive, § 450.111 focuses on process assurance of computing systems but fails to address the systems errors that can result from system process deficiencies (similar to software and hardware process deficiencies) in the development of all other types of complex systems, including systems of systems.

Finally, it is important to add that the current FAA training emphasis has been on the importance of the system process in preventing accidents today. The referenced FAA report provides many examples. Nancy Leveson has countless examples (*Safeware and Engineering a Safer World*) that substantiate just how important this system engineering process is and how useless software process assurance can be in the presence of poor system engineering.

Given this concern, CSF recommends FAA remove the prescriptive proposal as described above and add ACs that address system engineering processes and IMA (distributed software/hardware) development. Such a change will provide a significant improvement to safety over the current NPRM by addressing a regulatory gap for the system engineering process. The software section, as drafted in the NPRM, fails to

⁴³ ARP 4754A section 4.1.1 and 4.1.2 and FAA Report DOT/FAA/TC-16/39, “Safety Issues and Shortcomings With Requirements Definition, Validation, and Verification Processes Final Report”

address design errors and hazard vectors that can be introduced by the aeronautical data chain. Computer systems today are relying more on geospatial data that has the same level of potential to cause hazards as any other software or hardware in the system. This data needs to be taken into account as part of the safety analysis and hazard mitigation strategy.⁴⁴

CSF recommends the following:

- Remove the prescriptive computing system requirements
- Add ACs that address aeronautical data development and provide a means for granting a letter of acceptance. AC 20-153 is an excellent baseline.
- Work with industry to define or accept data sourcing standards like RTCA/DO-276.
- Work with other governments and international bodies to coordinate standards for government-sourced geospatial data.

The Flight Safety System regulations should be further streamlined and foster innovation for improved safety.

FSS as Hazard Control Strategy

Proposed § 450.101 states that an operator “must use flight abort with a flight safety system that meets the requirements of § 450.145”⁴⁵ but then proposed § 450.145 seems to give an operator the option of implementing a flight abort using “a flight safety system, or other safeguards agreed to by the Administrator”⁴⁶ This is confusing. “Flight Safety System” is defined in proposed § 401.5 as “a system used to implement a flight abort.”⁴⁷ So, does proposed § 450.145(a) mean the applicant may use something other than a flight abort (which seems wrong as a basic matter and seems to contradict § 450.101(c))? Or does it mean the applicant can implement flight abort using something other than a flight safety system (which does not seem possible given that the definition of FSS is that it is any system at all that implements flight abort)?

This type of confusion exists throughout these proposed regulations. These important details and contradictions will plague industry and FAA if they are promulgated in a final rule. These are the reasons why FAA should issue a SNPRM – it is likely not possible to identify and correct all of these errors in one pass.

FSS Reliability

The NPRM’s preamble and “Accepted Means of Compliance Table” identifies an untailored RCC 319 as the only government standard would meet the requirement for a design reliability of 0.999 at 95 percent confidence:

⁴⁴ Please reference RTCA/DO-200B and AC 20-153

⁴⁵ NPRM, 15427

⁴⁶ NPRM, 15428

⁴⁷ NPRM, 15414

Unlike part 417, the FAA would not propose specific design or testing requirements for an FSS. Instead, the FAA would accept specified government or industry standards as meeting the FSS reliability requirements. At this time, only one government standard would meet the requirement for a design reliability of 0.999 at 95 percent confidence and commensurate design, analysis, and testing, and that is RCC 319.⁴⁸

| | | |
|---------------|----------------------|---|
| 450.145 | Flight Safety System | N/A, except for sections noted below. |
| 450.145(a)(1) | 0.999 at 95% FSS | Range Commanders Council Standard (RCC) 319-14: Flight Termination Systems Commonality Standard |
| 450.145(a)(2) | 0.975 at 95% FSS | A tailored RCC 319-14. <i>The FAA is seeking a voluntary consensus standard as another means of compliance.</i> |

14 CFR Part 450 Subpart C Accepted Means of Compliance Table

There are a few confusing and misleading aspects of the above content. The preamble and proposed table are confusing because proposed § 450.35 would supposedly allow any operator (not just industry or government standards organizations as stated above) to petition the Administrator for other Accepted Means of Compliance with the 0.999 reliability requirement. The Table then indicates that FAA is seeking alternative means of compliance from industry standards organizations for only the 0.975 reliability requirements, not the 0.999 reliability requirement. CSF requests that FAA remove or correct the text above to reflect that any applicant can seek to add an Accepted Means of Compliance to FAA's draft Table, and in particular for § 450.145 (all sections).

Furthermore, the statement about RCC 319-14 being the only government standard that would “meet” the 0.999 design reliability and 95% confidence level requirements is misleading because the only reason RCC 319 “meets” that reliability level is that the document claims to by fiat in section 3.2.2.3:

“An FTS shall have a statistically predicted reliability with a 95% single-sided lower confidence boundary of at least 0.999...”

...The reliability requirement will be considered met through compliance with this document, which incorporates the following:

- *performance-oriented design requirements for components;*
- *comprehensive acceptance and qualification testing of components;*
- and*
- *pre-flight confidence tests of the entire system.”*

FAA has not explained why RCC 319 “meets” .999 reliability. Simply pointing to a document that claims by fiat that it meets .999 is not justification that the standard is technically met. Furthermore, FAA's inclusion of only an untailored RCC 319 in the Accepted Means of Compliance table is short sighted and misleading as there are other

⁴⁸ NPRM, 15319 - Emphasis added

industry standards more appropriate to point to for aspects of developing a .999 reliable system. For example, RCC 319 is not the only standard available for qualification testing. Traditional qualification testing includes testing at higher environmental levels and durations than what is seen in flight in order to reduce the quantities of components tested. For ordnance components, there are statistical comparisons that are well established for realizing a higher confidence level with a smaller number of units (for example: Bruceton, Langlie, Neyer tests), but there is minimal data available to quantify the reliability factor for RCC 319 or other standards.

The NPRM goes on to identify that there is effectively only one other method besides RCC 319 to demonstrate that a system meets .999/95% reliability standards, and that is to successfully test 2,995 units. The rationale on NPRM page 15319 about testing 2,995 units to get a 0.999 reliability at 95 percent confidence is severely flawed as it does not take into account the dual redundant string architecture traditionally implemented for an FSS. When 2 strings are present, each string only needs to have a reliability of 0.97. Even in the extreme case identified (no additional test margin), one would only need to test or have flight data from 98 strings to get the required reliability at 95% confidence.

The confusing text cited above and the incomplete nature of the preamble and Accepted Means of Compliance Table is not only disappointing in that it reflects stagnant thought about this issue, but it is also misleading in that it does not acknowledge other means of compliance with the reliability requirements that are also known and practiced in the industry.

CSF therefore makes the following recommendations:

- Please clarify that the reason compliance with RCC 319 “meets” the stated reliability requirements is that it claims to by fiat.
- Please also clarify that RCC 319 contains thousands of prescriptive requirements that may aid in design, but are not *required* to achieve a specified level of reliability, and that FAA would not require compliance with an untailored RCC 319.
- Please clarify that FAA’s statements in the preamble about testing 2,995 units did not adequately capture the testing requirements to meet .999 reliability and that FAA agrees with the assessment above.
- Please clarify that there exist other industry and government standards that achieve an accepted means of compliance with the reliability requirements of § 450.145(a), namely that the intent of proposed § 450.145 is for an operator to sufficiently demonstrate the required reliability of 0.975 or 0.999 through three aspects:⁴⁹
 - A reliability prediction showing a sufficient system reliability, with a defined confidence level for all inputs.

⁴⁹ The intent of this item is to capture the critical parts of RCC 319, all of which can be addressed through means other than strict compliance to RCC 319.

- A rigorous qualification test program conducted on all flight FTS components per the following (to be acknowledged in the Accepted Means of Compliance Table):
 - For non-ordnance components, a minimum 3 units shall be tested to qualification levels per one of the following standards:
 - SMC-S-016
 - RCC 319
 - Alternative approved by AST
 - For ordnance components, units shall be qualified per one of the following standards (note that the standard chosen may affect the demonstrated reliability of an ordnance component that could affect the system reliability prediction):
 - AIAA S-113A
 - RCC 319
 - Alternative approved by AST
- Preflight testing at the system or subsystem level to demonstrate functionality after installation

FSS Preflight Reporting Comments

CSF does not agree with FAA's proposal regarding the Reporting Requirements for Flight Safety Systems.

The proposal identifies that all test reports shall be delivered no later than 30 days prior to flight, however some testing (including preflight and day of launch checks) will not occur until less than 30 days prior to flight.

CSF recommends that the proposed rulemaking be updated to include an allowance for tests that occur less than 33 days prior to flight be submitted or made available within 3 days and in all cases prior to flight.

Proposed update:

450.213(d) Flight Safety System Test Data.

Any licensee that is required to use a flight safety system to protect public safety as required by § 450.101(c) must submit to the FAA, or provide the FAA access to, any test reports, in accordance with approved flight safety system test plans, no less than 30 days before flight, unless the Administrator agrees to a different time frame in accordance with § 404.15 of this chapter in the license.

For tests that occur less than 33 days prior to flight, such data shall be submitted or made available within 3 days of the test conclusion and before flight.

These reports must include:

- (1) A summary of the system, subsystem, and component-level test results, including all test failures and corrective actions implemented;*
- (2) A summary of test results demonstrating sufficient margin to predicted operating environments;*
- (3) A comparison matrix of the actual qualification and acceptance test levels used for each component in each test compared against the predicted flight levels for each environment, including any test tolerances allowed for each test; and*
- (4) A clear identification of any components qualified by similarity analysis or a combination of analysis and test.*

Surveillance and Publication of Hazard Areas

CSF recommends the FAA address two concerns with the draft text of the section on Surveillance and Publication of Hazard Areas. First, when the operator relies on an authority of a foreign country (such as Mexico), the operator has no recourse if the warnings provided to the foreign authority are not publicized.

Second, for a reentry vehicle operator, the rule must acknowledge that, unlike a launch event, the commitment to a reentry event can occur an hour or more before any realizable hazard in the designated flight hazard area. The reentry operator has no recourse if a hazard area is violated by third parties after appropriate warnings are publicized and the reentry commitment has been made. Any surveillance of the hazard area by the operator prior to the decision to commit to a reentry is of little value, and the obligation of the operator should be limited to best efforts to ensure warnings are publicized. Furthermore, the location of hazard areas can be in extremely remote locations or significant distances away from the launch/reentry site. In these cases, it is unreasonable for logistical and cost reasons to expect that a commercial company can provide such surveillance.

CSF recommends the following revision:

§ 450.161 Surveillance and Publication of Hazard Areas

*An operator must publicize warnings for each flight hazard area, except for regions of land, sea, or air under the control of a vehicle operator, site operator, or other entity by agreement. If the operator relies on another entity to publicize these warnings, **best effort must be made by the operator to ensure that a publication is issued.***

Tracking

CSF recommends that the FAA revise the tracking requirements in § 450.167. First, the "record in real time" requirement does not explicitly require that the data be telemetered

in real time, the requirement could be interpreted to require either real-time ground-based tracking or telemetry to the ground throughout the flight, creating a new requirement for "over the horizon" data in real time that is not required today. For a successful launch, it should be sufficient to capture and record telemetry on-board that can be telemetered later in a "store and forward" fashion to a ground station pass or via satellite relay after orbital insertion. For reentry vehicles, there is often a blackout period during reentry that would also impact the operators' ability to record in real time if the expectation is to record the data on the ground,

Another revision should be made to the requirement to "provide data to determine the actual impact locations of all stages and components,"⁵⁰ which could be interpreted to require continuous tracking of spent stages and other components such as fairing sections or jettisoned elements, all the way to the surface. We surmise that the FAA's intent here is to be able to "predict the expected impact locations" rather than "determine the actual impact locations".

For clarity, we recommend that the rule explicitly acknowledge that this requirement applies to a nominal flight, and does not apply to non-nominal flight of the vehicle, or the tracking of individual pieces of debris potentially resulting from a non-nominal flight.

CSF recommends the following revision:

§ 450.167 Tracking

*(a) General. During the **nominal** flight of a launch or reentry vehicle, an operator must measure and record the position and velocity of the vehicle. The system used to track the vehicle must provide data to **predict the expected** impact locations of all stages and components, and to obtain vehicle performance data for comparison with preflight performance predictions.*

A Final Rule would benefit from an alternative approach to the Ground Safety and Hazards Mitigation section.

CSF recognizes FAA's effort to reduce the prescriptive nature of previous ground safety and hazards mitigation requirements with a more qualitative approach that relies on an applicant's identification of hazards, an assessment of risks, a plan for elimination and mitigation, and for validation and verification (proposed § 450.185). This is another area where the FAA definition of "public" and property that is "public" conflicts with the practical co-location of an operator's personnel and contractors who are involved in a particular licensed activity and other co-located operations which may use the same personnel and contractors, or employees and property of the same company. These requirements also duplicate separate ground safety and hazards mitigation requirements of other Federal agencies, licensed site operators, or private site operators with multiple programs on property they own and control.

CSF agrees with the observations and recommendation of the ARC regarding the appropriate management of ground safety and hazards:

⁵⁰ NPRM, 15439.

“Federal ranges and licensed commercial spaceports should have authority to evaluate risk and compliance with public safety requirements for operations conducted on their facilities. This would eliminate duplicative management of ground safety by the facility operator and the FAA and would lessen the administrative burden of operators providing mission specific ground operations data to the FAA when such materials are already provided to, or even generated by, the facility operator...Allowing the site (Federal range or spaceport) to manage public safety for ground operations is most efficient as they best understand their surrounding area and any unique constraints. Requiring operators to maintain ownership of ground safety and demonstrating that compliance to the FAA results in unnecessary costs and ignores the role of the site.”⁵¹

CSF proposes FAA consider an alternative regulatory approach to Ground Safety and Hazards Mitigation that would give responsibility for assessing and controlling Ground Safety and Hazards Mitigation to the site operator, whether a Federal, state-local, or private launch and reentry site. This responsibility would include assuring validation and inspections, including inspection performance as necessary by the site owner/jurisdictional entity instead of FAA inspection personnel. These details would appropriately be captured in an AC to clarify FAA’s intent.

The FAA must address duplicative, conflicting and overlapping Federal rules.

The duplication and overlap of rules, regulations, and processes among the U.S. Air Force (USAF), National Aeronautics and Space Administration (NASA), and the FAA at Federal ranges and launch/reentry sites continues to impose unneeded costs and administrative burden on commercial operators. This absence of a single rule set threatens to create competitive disadvantages based on where a licensee conducts its operation as well as significant barriers for small-class vehicle providers. Small launch or reentry startups lack the resources to respond to the overlapping rules, regulations, and practices of separate Federal jurisdictions that impose their own requirements, some of which duplicate or conflict with those of other agencies. This is not a new issue for industry to raise, and Congress and the Administration have issued clear statutory direction to the Secretary of Transportation to resolve it through concerted streamlining efforts.⁵²

Regrettably, FAA chose only to acknowledge but not address the problem and the challenges of reconciling duplicative or conflicting requirements, range practices, and practices implemented at other Federal facilities. FAA’s approach to continue working with appropriate agencies through a common standards working group (CSWG) does not, in our view, effectively address this overlap of jurisdictions. To be frank, the CSWG has only addressed the overlap of FAA’s current 14 CFR Part 417 regulations with USAF range requirements. It has not addressed the disconnect or overlap between FAA’s 14 CFR Part 431 regulations and the USAF requirements for reusable launch vehicle operators at Federal ranges. FAA’s repeated statements that they continue to work the issue (*i.e.*, updates to a Memorandum of Agreement between the USAF and FAA) is little evidence that this streamlining effort, directed by both Congress and the Administration,

⁵¹ ARC Report page 32

⁵² Section 113, 2015 Commercial Space Launch Competitiveness Act; 2019 NDAA; SPD-2

has shown any meaningful progress. Stating that “this rule does not include language to eliminate duplicative requirements,”⁵³ does not seem, in CSF’s view, to address the directives of Congress, the policy of the Administration, or the expectations of industry.

CSF strongly disagrees with the FAA’s initial regulatory flexibility analysis in the NPRM, which definitively states that “no other Federal rules duplicate, overlap, or conflict with FAA’s launch and reentry licensing requirements.”⁵⁴ This is an astounding claim considering every operator at Federal ranges flying commercial missions must meet USAF requirements and FAA regulations. Commercial operators must secure authorization from the USAF to fly, and they must obtain an FAA license to fly and both of those authorizations cover the same aspects – flight safety, ground safety, public safety, national security, etc. CSF cannot rectify the FAA’s statements in the NPRM with this reality.

At the May 2019 COMSTAC meeting, the FAA stated that it cannot impose requirements on the USAF through a FAA rulemaking. Industry and the Administration have not asked FAA to regulate the Defense Department. We have asked for an explanation and a plan as to how these new proposed Part 450 regulations will align with USAF requirements to avoid duplication of authorizations. DOD and NASA have been part of this rulemaking – from the ARC, to interagency review before NPRM release – there has been ample opportunity for FAA to address this issue and it has failed to do so in a meaningful manner that would allow industry to actually consider how this proposed rule fits into a multi-agency authorization structure. CSF comments with the utmost urgency that a plan be presented to industry with the coming publication of the requested SNPRM for ending the multiple authorities currently enforcing requirements on this industry for the same overlapping purposes.

Another area of potential overlap that is not addressed by FAA in the proposal is the application of Occupational Safety and Health Administration (OSHA) regulations for industrial workplace protections and standards on FAA licensees. We believe much of the focus of the required FAA ground safety approach duplicates workplace industrial safety for employees or contractors who are protected under OSHA regulations, and subject to OSHA inspections. For example, an operator’s employees and contractors who are not involved in a specific licensed launch event may work in a shared processing facility or operational site. We believe these employees should not be categorized as “public” as it creates another environment of overlapping jurisdictions and potentially conflicting approaches to workplace inspections.

CSF is greatly concerned on behalf of its members, large and small, that the unresolved issue of duplicative, conflicting, and overlapping Federal rules may grow even worse under this FAA proposal with its new regulatory requirements and substantial revisions. This provides, in our view, another compelling argument for full disclosure of interagency agreements – whether completed or draft -- and a two-way dialogue between FAA and industry prior to publication of a SNPRM.

⁵³ NPRM, 15305.

⁵⁴ NPRM, 15408.

CSF supports the Office of Commercial Space (AST) reorganization that is underway.

On April 24, Secretary of Transportation Elaine Chao announced the planned restructuring of the FAA's Office of Commercial Space Transportation (AST). A significant and important aspect of the planned restructuring is the streamlining of AST's licensing operations. That undertaking is an important step occurring in parallel with the regulatory reform that is the subject of this rulemaking. As the office reorganizes, CSF encourages the FAA to emphasize improvements in the efficiency of application review and approval, which will benefit from performance-based, regulations supported by well-written guidance documents. We also urge the FAA to ensure that it invests in a result that will provide transparent, informative and regular communication regarding licensing application status. This desired end goal is not what CSF member companies experience in the current licensing process.

The NPRM provides for changes to the license application process, which are addressed in a separate section of these comments; however, a people-reliant process is only as good as those who are implementing it. The FAA AST is staffed with dedicated professionals who work diligently to ensure public safety in the course of issuing launch and reentry approvals. It is critical that those individuals have extensive technical expertise and capabilities as well as access to modern modeling and computational capabilities. It is also important that FAA AST evaluate how it empowers its staff to provide guidance and the tools and training they are given to support their knowledge of the rules they follow and the industry they are evaluating. For example, the FAA AST assigns a licensing lead to an application who is the primary interface with the applicant. That person should be well versed enough in the regulations, means of compliance, and AST's evaluation metrics to provide timely and actionable answers to an applicant's questions. Another example is an inspector observing a licensed activity - that person should be able to provide the licensee with guidance on regulatory and licensing compliance during the course of the activities should questions arise.

Streamlining AST to improve processes and benchmarking progress to measurable results is a good idea; however, the office must ensure that it is using the right metrics. FAA AST regularly achieves its 180-day timeframe for license approvals. However, that metric importantly fails to reflect the months and years between when an applicant begins pre-application consultation and when an application is actually submitted. Months and years pass while an applicant requests clarification on FAA AST's interpretation of a rule or an example of how the applicant might comply with that rule. This period of time prior to a license application being submitted is referred to as pre-application consultation and is intended to provide both an applicant and the FAA an opportunity to buy down risk that a major issue will arise once the application is submitted for formal review. Current practice does not provide applicants the risk mitigation that CSF believes was intended by the adoption of the pre-application consultation phase of license development because this time period is significant and lengthy and filled with uncertainty in the back and forth that occurs between the future applicant and the FAA.

The efforts underway at AST to streamline the office are encouraging and much appreciated. As that effort progresses, we encourage FAA AST to engage meaningfully

with its applicants and licensees to seek feedback on the greatest barriers to efficiency today. We also encourage FAA AST to ensure that as it revamps its processes, it balances the need to remain nimble and flexible with repeatability as it engages with a diverse and evolving industry.

Conclusion

The task of overhauling the current launch and reentry regulations is an immense undertaking and CSF appreciates the time and effort FAA has dedicated to the process. Although we believe there is still much work to be done, we are grateful of the opportunity to provide feedback on this tremendously important effort that will have long lasting effects on the American commercial spaceflight industry. We encourage AST to engage with CSF directly regarding any questions or concerns arising from these comments as we believe clarity and transparency to be of the utmost importance during the ongoing rulemaking process.

Sincerely,



Eric W. Stallmer
President, Commercial Spaceflight Federation