# Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee (ARC)

# ARC Recommendations
# Final Report

# April 30, 2018

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## 1. BACKGROUND

The Federal Aviation Administration (FAA or the Agency) chartered the Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee Aviation Rulemaking Committee (ARC) to provide a forum to discuss current and potential future regulations setting forth procedures and requirements for commercial space transportation launch and reentry licensing for FAA's consideration. FAA tasked the ARC to develop recommendations for a performance-based regulatory approach in which the regulations will state safety objectives to be achieved, and leave design or operational solutions up to the applicant.

FAA launch and reentry licensing protects public health and safety and property from the hazards of launch and reentry activities. In addition to public safety and the safety of property, licensing addresses national security and foreign policy interests of the United States, financial responsibility, environmental impacts, informed consent for crew and space flight participants, and, to a limited extent, authorization of payloads not otherwise regulated or owned by the U.S. government. Current regulations setting forth procedures and requirements for commercial space transportation licensing were based largely on the distinction between expendable or reusable launch vehicles. Specifically, parts 415 and 417 address the launch of expendable launch vehicles, part 431 addresses the launch and reentry of reusable launch vehicles, and part 435 addresses the reentry of reusable vehicles.

The regulations in parts 415 and 417 are based on Federal launch range standards developed in the 1990s. Parts 431 and 435 are primarily process-based, relying on a license applicant to derive safety requirements through a "system safety" process. While these regulations satisfied the needs of the commercial launch industry at the time they were issued, the industry has changed and continues to evolve, thus rendering the current regulatory structure cumbersome and outdated.

The current regulatory environment is viewed by some key stakeholders as overly prescriptive, lacking sufficient clarity, and unable to distinguish between "mature" launch operators and "startups." The FAA has also been able to determine that certain provisions within the existing regulatory framework are routinely requested for waiver by launch operators. This recurring practice further suggests that these provisions should be assessed for their continued validity.

## 2. OBJECTIVES AND SUMMARY OF ACTIVITIES OF THE ARC

### ARC Membership

This ARC was chaired by Di Reimold (FAA Co-Chair) and Michael López-Alegría (Industry Co-Chair).

The membership was comprised of industry representatives representing a diverse set of commercial space stakeholders.

A list of ARC members is included in Appendix A to this report.

### ARC Objectives

The FAA charged the ARC with addressing the following key areas as well as any other relevant items identified by members:

a. How should the FAA modify its current launch and reentry licensing regulations?

b. What performance-based regulations are needed to streamline launch and reentry licensing?

c. What standards are needed to demonstrate compliance with recommended performance-based regulations for launch and reentry licensing?

### ARC Meetings

**All Times are in Eastern Time in 2018**

**The ARC and Government Observers met in face to face meetings on the following occasions:**

Thursday, March 15th (9:00 AM – 12:30 PM)
Monday, April 30th (10:00 AM – 1:00 PM)

**The full ARC and Government Observers met via teleconference on the following occasions:**

Friday, March 23rd (12:00 PM – 2:00 PM)
Friday, April 13th (12:00 PM – 1:30 PM)
Wednesday, April 18th (12:00 PM – 1:30 PM)
Monday, April 23rd (12:00 PM – 1:30 PM)

**The ARC met via teleconference on the following occasions:**

Tuesday, March 20th (12:00 PM – 2:00 PM)
Tuesday, March 27th (12:00 PM – 2:00 PM)
Tuesday, April 3rd (12:00 PM – 2:00 PM)
Tuesday, April 17th (12:00 PM – 1:30 PM)
Wednesday, April 25th (12:00 PM – 1:00 PM)

## 3. DISCUSSION

The FAA formed this ARC to focus on addressing options to update and streamline the licensing process for launch and reentry vehicles. There is a separate ARC looking directly at National Airspace System (NAS) integration, and although the status quo of current licensing inputs to other NAS users was maintained in the ARC's recommendation, NAS impacts were not explicitly addressed in this effort.

Following the first meeting of the ARC, the FAA provided industry participants with a list of questions to help inform their work on developing regulations. The full set of questions can be found in Appendix B. Industry was asked to provide responses to these questions by close of business on Friday, April 6, 2018. The full submission, along with the accompanying email text, can be found in Section 4 of this report (ARC Recommendations). On April 13th, the FAA provided industry with a set of follow-up questions to provide further clarity. The full set of follow-up questions can be found in Appendix C. The responses to these questions can be found in Section 4 of this report (ARC Recommendations).

Due to the limited time available to the ARC to give industry input, providing answers to both sets of questions posed by the FAA was viewed as a focused means to achieve the three tasks called out in the ARC charter. As a result, the recommendations are comprised exclusively of responses to the initial and follow-up questions.

In order to address the questions, the ARC split into separate groups to tackle each question separately. Each industry participant volunteered to participate in any group for which they were interested in providing input. Each question had a designated leader that was responsible for collecting data from the group participants and constructing a narrative response based on the input received. These narratives were then briefed in a conference call to all of the ARC members, including those who had not participated in the focused groups. The designated leader then considered inputs from the broader group in producing a final draft. Once completed, the draft text of each response was sent to the Industry Co-Chair and the Executive Secretary to combine all of the responses. The full document was shared with the group at large, and participants were given some time to provide final edits. This process was repeated for the second round of questions.

The above process was adopted to allow healthy debate and deliberation between entities holding differing opinions on various topics. The members of the ARC represent a broad swath of industry, with sometimes widely disparate views on many issues. Nonetheless, all members voiced strong support for streamlining the launch and reentry licensing process, and demonstrated that support by working diligently and collaboratively to reach consensus on a broad array of topics within a very compressed schedule. In some cases, the failure for all to agree to specific responses, and therefore to reach full consensus, was driven by a lack of time. Inability to assess how certain aspects of responses might affect – or contradict – others, the potential for unintended consequences, and the practical difficulties in assessing all stakeholder equities within a given company were all cited as obstacles to gaining concurrence.

Nonetheless, the responses to the two rounds of questions from the FAA as put forth as recommendations in Section 4 represent the general consensus of the ARC. In order to provide complete transparency into any responses for which there is not full consensus, each ARC member has expressed its level of concurrence with this report, and cited its objection to any specific aspects of the with which it did not concur. These summaries are presented in Appendix F.

The ARC feels strongly that its continued involvement in the rulemaking process beyond the deadline of April 30, 2018, would be of great benefit and would significantly improve the final Notice of Proposed Rule Making. This involvement could take one or more of several forms – continued debate on the questions posed by FAA and industry responses, development and refinement by industry of proposed rule language and provision of that language to FAA (see Section 5), and sharing by FAA of draft rules under development and attendant discussions with industry.

## 4. ARC RECOMMENDATIONS

As noted above in Section 3 (Discussion), the ARC is presenting its recommendations to the FAA in the form of responses to the two sets of questions FAA presented to the ARC.

On April 6, 2018, the Industry Co-Chair sent FAA the ARC's responses to the FAA's initial set of questions. Reproduced below is a copy of the cover letter that accompanied those responses:

> Di - Please see attached a consolidated industry report addressing the topics FAA has requested the ARC's industry representatives to consider in the matter of improving Launch License regulation, rules and practice.
>
> This document represents a monumental effort by the industry members of the ARC. Remarkably, broad consensus was achieved on the vast majority of the topics, in particular, on the thorny issue of range jurisdiction, companies as diverse and competitive as Blue Origin, Boeing, Orbital ATK, Sierra Nevada Corporation, SpaceX and ULA came together and agreed on the proposed solution. We hope the significance of such consensus is appreciated by our government partners.
>
> It is important to note, however, that there was not unanimity on all topics. In particular, Lockheed Martin does not concur with the body of the responses in the attachment, in great part due to both being added late to the ARC and the accelerated timeline of the ARC - there was no time to consider the implications of individual responses to other parts or to other existing regulations. While they strongly support streamlining and reducing the regulatory burdens of the FAA-licensed activities, they are concerned generally about the implications for safety. With respect to the streamlining approach taken to safety requirements, they are not comfortable with generic recommendations to remove safety requirements or to move to 'guidance only' without including specifics of what the replacement approach would entail. They highlight that Crew Rest is one example of a safety requirement that should not be removed.
>
> Likewise, Boeing was unable to fully endorse the attachment due to the large scope and compressed timelines to develop consensus and integrated inputs. For the most part, they found the sub-elements they were able to review are satisfactory, but they have concerns regarding the areas they have not had adequate time to review and assess their position.
>
> While industry has gone to considerable lengths to address FAA on each of the of the proffered topics, please note this response is by no means exhaustive and industry shall continue working on drafting rules including specific language over the next few weeks.
>
> You'll notice that not all of the questions have been answered; I've tried to highlight those that haven't. One question - "Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and

estimates when possible." was listed in every section. Although it was answered in some cases, we provide the following generic response:

> Given the extremely short time-frame and necessarily general nature of the ARC's consensus answers to the tasking questions, we cannot provide detailed or quantitative data on the potential impacts of DOT/FAA accepting our recommendations. Ultimately, we would need to be proposing, or reviewing, specific regulatory language to develop more specific estimates.
>
> That said, to the extent that any proposed change leads to a single, integrated and streamlined performance-based regime for ensuring public safety during licensed launch and reentry activities, with the U.S. government moving towards placing all space transportation service acquisitions under DOT licensing, then industry operators will be able to get better and better not only at conducting operations safely but innovating to improve safety, reliability, mission success, and of course affordability. Instead of facing multiple sets of conflicting rules, or confusing rules which are prescriptive or internally inconsistent, operators will be clear on what the expected outcomes are and will get better and better at proving achievement of those outcomes, not just turning in better-filled-out-forms.

Just as importantly, a more appropriate regime should be significantly easier for FAA/AST to administer, so that the regulator can focus on the desired end result rather than procedural inputs. This will not just allow the FAA/AST to provide more licenses at less cost, but generally speed up licensing and make it more consistent across all applicants, vehicle types, and locations. It should also allow FAA/AST the freedom to better understand the technological and process innovations taking place in industry so the government can look ahead to further streamline or tweak the regulatory regime.

While immediate benefits to both licensee and regulator will be, in total, very substantial, the second and third-order effects of these improvements, while hard to predict, could in fact be transformative in terms of achieving strengthened national security and economic growth, as well as improved public safety even as operational cadence, technical and geographic diversity, and sheer scale of activity all dramatically increase.

Finally, industry members of the ARC have agreed that the following 7 points should form the basis for consideration in any case:

"The ARC should focus on the following components and by doing so will result in initial and recurring safety and economic benefits through increased flexibility, reduced paperwork burden and an expansion of commercial activities."

1. Performance based

- Regulations will measure the ability of the applicant to comply with Ec limits.

- Means of compliance may vary and should be left to the operator

2. Flexibility

   - Adopt a single license structure to accommodate a variety of vehicle types and operations and launch/reentry sites

   - Allow for coordinated determination of applicable regulations prior to application submission

   - Develop regulations that can be met without waivers

   - Use Guidance Documents to facilitate frequent updates

3. Reform Pre-Application Process and Requirements

   - Use “complete enough” as the real criterion for entering application evaluation and remove the requirement for pre-application consultation.

   - The scope of an applicant-requested pre-application as the basis for a complete enough determination should use a level of rigor approach, considering both as applicant’s prior experience and whether the subject vehicle is known or unknown.

4. Defined review timelines

   - Support significantly reduced timeliness and more efficient review

   - Increase predictability for industry

   - Create reduced review timelines for both new and continuing accuracy submissions

5. Continuing Accuracy requirements

   - Continuing Accuracy submissions shall be based upon impact to public safety as measured by Ec

6. FAA Jurisdiction

   - Limit FAA jurisdiction to activities so publicly hazardous as to warrant FAA's oversight

   - Identify well defined inspection criteria

7. Eliminate Duplicative Jurisdiction on Federal Ranges

- New rules should reflect streamlined approach to jurisdiction for launch and reentry activities on Federal Ranges.

- Respond to NSpC recommendation to revise licensing regime in coordination with members of NSpC

The industry participants have put forth a significant effort in responding to the questions posed; we look forward to hearing from our government team members' reaction.

## 4.1. Initial Question Responses

The initial set of questions that FAA presented to the ARC were divided into four areas: Scope, Launch Safety, Reentry Safety, and Other Aspects of Licensing. The set of questions also included an appendix with questions related to additional launch safety topics. FAA asked the ARC to concentrate on those areas believed by industry to be most critical. The FAA's questions (in bold), and the ARC's responses to them (in italics), are reproduced below in their entirety.

### Scope of the Rulemaking

**The scope of the rulemaking is the licensing of launch and reentry activities, involving expendable and reusable, orbital and suborbital, crewed and uncrewed, guided and unguided, and conventional and hybrid launch and reentry vehicles. The FAA plans to focus on cost-effective public safety-related regulations. The FAA does not intend to address the following in this rulemaking: financial responsibility, orbital debris mitigation, licensing of the operation of launch and reentry sites, and experimental permits.**

1) ***Scope.*** **What aspects of launch and reentry licensing should the FAA address in this rulemaking?**

*In general, 14 CFR Parts 413, 415, 417, 431 and 435 should be addressed. Details are provided in responses to the remaining questions.*

### Launch Safety

**The commercial launch industry is extremely diverse. Measures used to protect public safety during a launch depend on a number of factors, including whether the launch vehicle is guided or unguided, whether the launch vehicle is orbital or suborbital, whether the launch vehicle is hybrid or conventional, where the launch takes place, the explosive potential of the launch vehicle, whether the launch vehicle contains toxic propellants, and others. Ideally, the consequences of a launch vehicle failure should dictate the level of rigor that a launch operator**

**should apply to system safety, flight safety systems, flight safety analysis, etc. The level of rigor of FAA's application evaluation could vary in a similar manner.**

**The FAA seeks industry recommendations on the safety topics listed below. The Appendix includes additional launch safety topics that the ARC may address if time permits. Each response should provide justification, and should be comprehensive enough to address the diversity of current and future operations. Because the FAA regulates launches only to the extent necessary to protect public health and safety, safety of property, and the national security and foreign policy interests of the United States, industry should identify why each recommendation is necessary to achieve this mandate.**

1) ***System Safety.*** **Parts 431 and 435 are primarily process-based, relying on an applicant to derive safety requirements through a system safety process. Part 417 is less reliant on system safety.**

    a. **To what extent should the FAA require a launch operator to conduct a system safety process in order to derive safety requirements for its launches?**

*The system safety process should form the core of the FAA requirements. The system safety process identifies hazards and develops control strategies which are then verified by means of flight safety analysis (risk based, containment based, directed energy based) and relevant operational constraints (allowable trajectories, flight rules, etc.) and means of meeting those constraints (flight safety system, pilot training, etc.).*

    b. **What current requirements related to system safety should be retained as is, modified, or eliminated?**

*Recommend improving the definition of safety requirements and level of detail the FAA wants to see from the launch provider to satisfy Part 431 Subpart C. For example, section 431.35(c) should be retained and expanded to include risk-informed decision making and continuous risk management requirements that form the core of the applicant's safety case.* c. Please identify any cost-effective performance based regulations regarding system safety.

    c. **Please identify any cost-effective performance based regulations regarding system safety**

*By approving a process rather than approving artifacts, FAA can focus on spot-checking and value-added deep dives of items that can affect public safety thereby reducing bureaucratic burden on both the applicant and FAA. Application updates should focus on change impact assessments rather than comprehensive update of license application materials.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on system safety?**

*The NASA Risk Management Handbook provides a great structure for how to meet risk based requirements by means of an evolving process.*

**e. How should the FAA apply a level of rigor concept to system safety?**

*FAA should initiate a comprehensive review of an applicant's system safety processes at the start of the pre-consultation phase to define the appropriate level of rigor for that applicant/vehicle program. An appropriate level of rigor concept is to scale required verification requirements (e.g. test plans and results) by vehicle and operator category (determined in Pre-App) and relative risk (vehicle hazards and population exposure). Categories could include for example: new vehicle by new operator, proven vehicle by experienced operator, derived vehicle by experienced operator, vehicle hazard class, and sparsely/densely populated areas.*

**f. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*By identifying entrance and exit criteria for pre-app (addressed in another question), focusing on process approval with scalable verification requirements, and application updates based on change impact assessments, the goal is to reduce the regulatory burden in terms of time spent on TIMs and time spent generating paperwork by at least 50%. For a smaller scale program (suborbital, contained trajectories) we estimate this to be 2 FTEs. For full scale vertical orbital launch vehicle, we estimate this to be 3-5 FTEs.*

**2) *Flight Safety Systems.* A flight safety system is often used for a launch to meet collective and individual risk criteria. It is also used in a launch area to prevent low probability, high consequence events. Current design and testing requirements in part 417 ensure that the flight safety system is highly reliable. Part 417 does not, however, cover autonomous flight safety systems explicitly.**

**a. What current requirements related to flight safety systems should be retained as is, modified, or eliminated?**

*In a performance-based licensing scheme, the regulations should be flexible with regard to flight safety systems and allow an operator to propose a means of achieving the performance metric without dictating a specific hardware approach (AFSS or FSS). For example, an operator should be able to propose an alternative to having a destruct flight termination system.*

*Prescriptive requirements, like those in the current regulations, should be moved to a guidance document. It is of high criticality that the guidance document includes updates to*

*support Autonomous Flight Safety Systems (AFSS). This update will aid applicants and the FAA's evaluators throughout the licensing process. The most comprehensive and up-to-date set of requirements regarding FSS is found in RCC 319. See attached table of contents from RCC-319 with annotations as to whether the content should be retained (possibly in regulations but most likely in a guidance document). Requirements are identified with regard to level of revision required – minor (<25% revision) or moderate (~50% revision) – prior to use. Drafts of proposed rules are in work and will be forthcoming ASAP.*

**b. Please identify any cost-effective performance based regulations regarding flight safety systems. Recommendations should include:**

**i. When should a launch vehicle be required to have a flight safety system?**

*A flight safety system should not be required; instead, an operator should be required to meet the allowed risk calculations in the Flight Safety Analysis. An operator may choose to utilize a FSS to meet Ec or other performance requirement, but specific systems should not be dictated by the regulations.*

*FSS, with an update to account for AFSS, should be described in a guidance document as a possible method to meet the allowed risk calculations in the Flight Safety Analysis (i.e. Ec or other performance requirements).*

**ii. What should determine the flight safety system's necessary reliability, and how should a launch operator demonstrate it?**

*A FSS's necessary reliability should be determined by the factors contemplated by the flight safety analysis. For example, the population density, the realm of reasonably foreseeable failures (determined by FMECA or some other verified method), the trajectory/size/explosive capabilities of the vehicle – all of the variables that go into a flight safety analysis should be used to determine what the required reliability of an FSS should be. This approach, however, may result in a lower required reliability than has been used historically (i.e., .999 reliability in Part 417). This may be wholly appropriate, though, since it is based on data about the actual risk factors that govern the flight safety analysis. Vehicles with low risk to the public (sparsely populated, smaller vehicle) may require a lower reliability.*

*Current approach taken by Part 417 is to identify requirements that if complied with, ensure 0.999 predicted reliability at the 95% confidence level. See for example 417.303(c), 417.309(b), Appendix D (D417.5), Appendix E (E417.41). This approach could be inappropriate for smaller vehicles, or suborbital trajectories (other?). For vehicles with proven vehicle reliability from flight history, i.e., a vehicle is 99% reliable (1 failure in last 100 flights), question whether it is appropriate to require an FSS with proven reliability of 0.999 at the 95% confidence level. Whether talking about proven vehicles or new vehicles, the answer depends on the risk posed by a catastrophic failure, and that is dependent on many variables. Problem should be divided*

*into risk spectrum, for high consequence, low probability events, .999 @ 95% CI is appropriate with full spectrum environmental test plan, acceptance test plan used to demonstrate reliability. For low consequence, low probability event (other end of spectrum), a reduced confidence interval (less than 95%) or lower reliability could be acceptable with HIL or integrated test used to demonstrate compliance.*

*Certain aspects of FSS can be tested in flight (e.g., using AFSS in shadow mode and testing function with no ordnance on board or no destruct capabilities active).*

**iii. What other safety mitigations are available to prevent low probability, high consequence events?**

*Vehicle Health Monitoring or similar systems that detect failures and take action such as terminating thrust when quantified risk allows use of a non-ordnance based FSS system; these examples can significantly reduce the risk to the public and may be appropriate for some vehicle architectures.*

*Consider population control, i.e., move people (or restrict access, close roads) when possible, until vehicle reliability is proven. As probability of failure reduces, population control will be less disruptive.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight safety systems?**

*Current expected casualty (Ec) requirements would be an appropriate performance standard for flight safety.*

**d. How should the FAA apply a level of rigor concept to flight safety systems?**

*Scale required verification requirements (e.g. test plan, test results) by vehicle and operator category (to be determined during course of application process) and relative risk (vehicle hazards and population exposure). Categories could include: new vehicle by new operator, proven vehicle by experienced operator, derived vehicle by experienced operator, vehicle hazard class, and sparsely/densely populated areas.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*Current FSS regulations are overly burdensome. A system safety approach will reduce the number of documents and waivers produced and reviewed in response to outdated and oftentimes non-applicable requirements.*

3) **Flight Safety Analysis. A number of quantitative analyses are used to demonstrate that a launch will meet collective and individual risk criteria, as well as to determine aircraft hazard areas, ship hazard areas, destruct lines, etc.**

   a. **What current requirements related to flight safety analysis should be retained as is, modified, or eliminated?**

*Content of regulation:*
*The content of Part 435.35 and 431.35(a) in its current form or future form should be retained and modified to include water-borne vessels similar to how the Federal Ranges have adjusted their approach to water borne vessels in hazard areas. Specific risk based protection criteria should be developed for aircraft. Overall the goal would be to update the analysis approach to one that risk analysis based and can take into account different unanticipated scenarios, like a ship in a hazard area, and still analysis total risk and allow an operation to continue if the risk criterion is met.*

*Acceptable phase-based analysis approach:*
*Given the philosophy of allotting a separate risk budget for launch and reentry based on the fact that health monitoring and reentry enable precedes reentry, the same philosophy should apply to overflight where health monitoring and a decision to proceed precedes allowing a vehicle to continue through an overflight gate. RCC 321-07 takes steps to provide a phased based flexibility in the Flight Safety Analysis. See the following excerpt:*

*"The per mission risk criteria specified in RCC 321-07, Chapter 3, should be compared to the total risk posed by an operation (i.e. the aggregated risk from all phases of an operation) unless there is a decision point between distinct phases where all of the following conditions are satisfied:*
*(1) The vehicle has sufficient controllability to allow operational options that could reduce the risk posed by a subsequent phase (or phases) significantly.*
*(2) The decisions as to whether or how to proceed with a subsequent phase is based on a risk assessment that is conducted or validated just prior to each phase of flight.26*
*(3) The risk assessment for subsequent phases is made or validated using updated vehicle status and updated predictions of flight conditions."*

*Chapter 4.2.4 (h) p 67 of the RCC 321-07 supplement roles into separate risk budgets, where one can build the case for the above 1,2,3.*

*Who conducts the analysis and has access to common inputs:*
*Currently the application process expects the applicant to provide a completed Risk Analysis (Ec) as part of a complete enough application. This leaves an applicant with a few choices to complete the analysis:*

1. *Have a Federal Range perform the analysis*
2. *Hire a 3rd party company to perform the analysis*
3. *Internally conduct the analysis*

*Though some of the Federal Ranges claim they can do the analysis for operations anywhere in the world, they really are only experts for operations at their Range. This limits options for operations outside of a "typical" activity at a Federal Range to have the Ec analysis performed. In this scenario, the Federal Range performs the work as a reimbursable service to the applicant and the service is not competed commercially.*

*There are a few commercial companies that perform Ec analysis as a service to an applicant and this does allow for commercial competition, but it does prove to be operational challenging and costly in cases where an applicant wants to iterate on trajectory development and get rapid Ec feedback on a mission design. In some cases, an agreement with a commercial company that performs the Ec analysis can be a conflict of interest as the Federal Ranges and the FAA often work with these companies to develop or validate analysis runs as part of an applicant's license.*

*In the 3rd scenario of an applicant performing the analysis internally, this provide the most flexibility to the applicant, but can provide the most risk to providing a complete enough analysis. Furthermore, there are challenges to internally performing the analysis due to an applicant's lack of access to critical data. An example would be either a launch or reentry activity at or near KSC and CCAFS. A very accurate population model is maintained by the Air Force, but some applicants have been told they cannot have access to the data for their own Ec analysis. Overall, if the FAA expects an applicant to provide the Ec analysis as part of the application, all data required for the analysis should be accessible to all applicants regardless if they choose to do the analysis internally or with a 3rd party. This would provide the most commercially competitive environment, avoid any conflict of interests on the government's side, and set level expectations on what acceptable means of compliance are for the analysis.*

*It is recommended that common inputs to the Flight Safety Analysis (Ec) such as the following but not limited to be publicly accessible to applicants and or 3rd party services they may be using to complete the analysis as part of a complete enough application.*

1. *Population data where higher fidelity models already exist*
2. *Aircraft and ship catalog*
3. *Wind models where higher fidelity models already exists*

*It should also be noted, that the FAA could also comply with this recommendation by publishing common data sets as input to the analysis that would then result in an applicant*

*meeting a complete enough review based on those inputs. This would alleviate any issues with the Air Force, for example, in not wanting to disclose sensitive data publicly.*

*Definition of when the analysis begins:*
*Particularly for horizontal vehicles, one of the challenges is defining when "launch" takes place and subsequently when the flight safety analysis should begin. Currently, the regulations seem to define that launch begins when a vehicle is prepared for flight, rather than when the vehicle is within the launch window. Furthermore, a hybrid system that is performing an operation without the intent to launch is allowed to fly under an Experimental Airworthiness Certificate (EAC) or equivalent authorization and the impacts to public safety are considered during that certificating process. But when a hybrid system has an intent to launch, the operation is performed under a FAA-AST license which requires a flight safety analysis (Ec). Though the flight profile and configuration of the captive carry portion of the operation may be the same and of that conducted under the EAC, a different and more restrictive analysis is required. This points to a disconnect between the FAA's evaluation of public safety for the same operation. It is recommended that the flight safety analysis begin for a launch license at the moment the hazardous configuration of the hybrid system is different from that approved under an EAC or equivalent authorization. This would then meet the intent of protecting the public for licensed operations while also not setting different standards for the same operation under different authorities.*

**b. Please identify any cost-effective performance based regulations regarding flight safety analysis.**

*Flight safety analysis fidelity and associated data requirements should scale with operator maturity, vehicle heritage, vehicle hazards, and public exposure in terms of low, medium, high fidelity requirements.*

**c. Is there an alternative to flight safety analysis that would provide an equivalent level of safety?**

*Containment, conditional Ec for trajectory design, directed energy and pilot training (as used in air shows) should all be options for making a safety case for a proposed operation. The substantial dwell time rule of 431.43(d)(1) and conditional risk rule of 431.43(d)(2) should be offered as a means of supporting a safety case for trajectory trade studies rather than a blanket requirement. For example, put these items in guidance documents for use when appropriate.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight safety analysis?**

*Part 417 Appendix A through C should be moved into an AC providing acceptable methods of meeting the requirement for higher fidelity analyses. However, the approach to vehicle reliability documented in FAA's "Guide to Reusable Launch and Reentry Vehicle Reliability Analysis" is preferable to Table A417-3 in that it allows for analyses representative of vehicle architecture: bottoms-up, and hybrid bottoms-up approaches taking into account vehicle fault tolerance, reliability testing, and operator maturity. Part 420 Appendix A through D should be moved or copied into an AC providing acceptable methods of meeting the requirement for lower fidelity analyses. Guidance from aviation air show risk management should be used to develop an AC focused on winged, piloted vehicles where Ec analyses may not be the best approach. Defining a minimum set of data requirements (for verification of first flight proposals) such as those in Table A2.4 of AFSPCMAN91-710V2 would improve efficiency by defining expectations and reducing iteration.*

*The FAA also has a Flight Safety Analysis handbook that has a lot of information contained in it. It is a good guide to help support high fidelity analysis but is cumbersome for new applicants or those performing an operation that maybe does not require the high fidelity detailed in the handbook. The FAA would benefit from updating the flight safety analysis handbook to cover more of the essential items of the analysis and publishing the details in an additional AC focused on high fidelity modeling.*

**e. How should the FAA apply a level of rigor concept to flight safety analysis?**

*Develop a matrix assessing operator maturity, vehicle heritage, vehicle hazards, planned operation, and public exposure to determine whether a low, medium or high fidelity analysis is required, and what level of verification is required. For example, a high fidelity analysis (e.g., for low probability, high resulting risk failures) may trigger the requirement for a flight safety system with 0.999 @ 95% CI reliability verified by means of a comprehensive test plan. A low fidelity analysis may only require a means of terminating thrust, demonstrated to work in subsystem or integrated testing in nominal conditions. There needs to be flexibility in determining the rigor of the Flight Safety Analysis and subsequently the Flight Safety System as different vehicles and operations could require very different approaches. For example, a gliding reentry vehicle may take a very different approach to a flight safety system than a launch vehicle with large explosive equivalent and a thrust.*

**f. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*By scaling analysis and verification data requirements depending on vehicle hazards (e.g. size and explosive yield), this provides a lower bar to entry for new companies operating new suborbital vehicles and a higher bar for larger orbital vehicles, which may, however, be lowered for operators who have gained experience by conducting a successful suborbital (or smaller orbital) vehicle program. By specifying required level of fidelity and providing guidance for each level of fidelity this should reduce iterations on analyses by at least 30%, resulting in reduced FTE costs devoted to licensing processes. Further, FAA should not be in the business of repeatedly performing independent flight safety analyses for each mission. An independent assessment can be performed during licensing to approve the operator's flight safety analysis process for an envelope of trajectories, but on a per mission basis it should be the operator's duty to perform the analysis, rendering the flight specific output an inspect-able item. By having a common database of inputs to the Flight safety analysis, the FAA would be reducing the risk an application is not complete enough while setting more clear expectations for an applicant about the required level of fidelity.*

**4) *Maintenance and Reuse.* Current regulations address the maintenance and reuse of launch vehicle components and vehicles through the system safety process.**

**a. What current requirements related to maintenance and reuse should be retained as is, modified, or eliminated?**

*This topic should be addressed in Part 431/435 Subpart C (or whatever new equivalent section results from this exercise). Requirements should be focused on maintaining reliability inputs foundational to the system safety process. For example, components on reusable launch vehicle are designed tested and qualified for a certain number of flights. Regulations aimed at vetting the process that verifies those components for a certain number of flights should define the veracity of the maintenance requirements. Current rule 417.13(a)(3) cannot exist in the new regime because it ignores RLVs. For example, as currently written, it requires the removal and recompletion of acceptance testing prior to reuse of an FTS component between each and every flight which is inefficient and an unacceptable schedule and personnel cost. While the systems safety basis is good, there would be significant value in identifying a qualification and acceptance test baseline for RLVs which addresses qualification and acceptance test levels/durations that are required for testing. Current rule 417.13(b) is written in the context of an ELV where acceptance testing and stresses must exceed the predicted flight exposure. While this approach can be extended to RLVs, that testing will often consume an unnecessary amount of the unit's life and potentially reduce overall reliability. In many ways, this is the equivalent of driving 100,000 miles on a new car before selling it and rendering it much closer to end of life before it even starts its mission.*

*An alternative path should allow for a screening process that is designed to weed out latent defects and ensure that only "grade A" units are used in flight. A "Highly Accelerated Stress Screen" (HASS) is probably the best, well known, approach to doing this. Recommend using: A Highly Accelerated Stress Screen (HASS), performed per GMW8287 (2017), as approach to acceptance testing. GMW8287 is a General Motors-produced, but publicly available on IHS, etc., standard for HALT/HASS testing that has wide acceptance in the automotive industry and beyond.*

**b. Please identify any cost-effective performance based regulations regarding maintenance and reuse.**

*In general, reuse requirements should be established in the license application so as not to delay subsequent flights by greater than 14 days.*

*FAA should require a maintenance and maintainability plan for any vehicles or vehicle components intended for reuse, allowing flexibility for the operators to define the details of the plan appropriate for their architecture.*

*The overall objective is to ensure component and subsystem exposure to mission cycles does not degrade reliability to the extent that it would exceed the vehicle reliability threshold necessary to maintain compliance with the public safety risk requirements. The regulatory goal should be to avoid a recertification/re-approval approach and move towards reliance on the system safety process objectives, design-for-reuse objectives, maintenance process objectives, and evidence of compliance with those objectives. For example:*

1. *Design-For-Reuse Objectives*
    a. *Identification of requirements for RLV useful life/mission cycles*
    b. *Design verification against RLV useful life/mission cycles requirements*
    c. *Identification of life-limited components*
2. *Maintenance Process objectives*
    a. *Maintenance Plan*
        i. *A maintenance plan should define the controls necessary to ensure that public safety hazards associated with the failure of reused systems, subsystems, failures continue to be adequately controlled.*
        ii. *Life status monitoring criteria for life-limited components*
        iii. *Identifies inspection intervals*
        iv. *Component inspection criteria*
        v. *Component replacement criteria*
        vi. *Removed component disposition criteria*
        vii. *Maintenance records*
    b. *Return-to-service approval criteria covering:*
        i. *Life status of life-limited components*

ii. *Record of removed or replaced components*
iii. *Configuration conformity criteria*
iv. *Approval authority, roles, and responsibilities As mentioned above, HASS testing as an alternative for FTS electronics (compared to the traditional 417.13 requirements) is highly recommended*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on maintenance and reuse?**

*For vehicles and space flight systems that fall under other areas of oversight, such as AVS, requirements and practices such as FAA-approved Maintenance Planning Documents (MPDs) should be recognized as a possible means of compliance to AST rules where applicable.*

*See references to HASS and GMW8287 in answers to previous questions. Some requirements of Title 14 CFR Part 43 for aviation maintenance requirements are incorporated into proposal in question b above and d below.*

**d. How should the FAA apply a level of rigor concept to maintenance and reuse?**

*Example of a recommended approach:*

1. *Suborbital low cross-range*
    a. *Flight Safety System (FSS) useful life/mission cycle requirements and verification results.*
    b. *FSS return-to-service approval criteria.*
    c. *Maintenance records available for inspection upon request*
2. *Suborbital high cross-range*
    a. *14 CFR 43.5 across all vehicle systems necessary for continued safe flight and landing.*
3. *Orbital*
    a. *New operator – All design and process definition artifacts demonstrating compliance with design and maintenance process objectives, plus evidence of execution compliance for a minimum of [x] missions.*
    b. *Experienced operator – All design and process definition artifacts demonstrating compliance with design and maintenance process objectives. Evidence of execution compliance for any mission made available upon request.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*The proposal moves away from a potentially costly and inefficient recertification/re-approval reuse approach towards a design-for-reuse paradigm paired with robust maintenance as an essential component for maintaining continued compliance with public safety risk requirements.*

**Reentry and Landing Safety**

**Many of the issues discussed under launch safety apply to reentry as well. Currently, the safety of reentries is primarily achieved through an applicant implementing a system safety process to derive and verify mitigation measures, and quantitative risk analyses.**

**1) Please identify any cost-effective performance based regulations regarding reentry safety.**

*The framework described in previous responses to scale launch licensing scrutiny based on operator experience, vehicle hazards, and public exposure are applicable to reentry and landing. Specific areas of improvement include updating 431.43(e)(2) to allow for autonomous reentry enable given the reliability of on-board systems; operators seeking to dispose of upper stages or spacecraft over broad ocean areas should not face a greater regulatory burden than those proposing safing on-orbit given increasing orbital debris hazards; a relative risk approach should be considered for reentry trajectory selection where potential reentry trajectories are compared to alternatives such as random reentry; reentry from outer space should include stages returning for reentry and landing given continuous health monitoring prior to autonomous reentry enable. Furthermore, it is recommended that there be an alignment of reentry safety processes with the safety processes for the other phases of the flight.*

*For operations on a Federal Range, the FAA, Range, and NASA, should align their analysis regarding reentry flight plans and so that there are not separate requirements based on the applicant or where they are performing the operation.*

*Current regulations define ejected payloads that are recoverable as reentries. It is recommended that if a payload recovery system has received an FAA/AST approval for re-entry, it would be "file and fly" eligible" if it has not gone through any material change that could potentially affect public safety. (for example: If you flew an ejectable 1U payload with a recovery system with FAA/AST review the next flight of the 1U would fall under the file and fly provision.)*

*During a reentry activity, if an abort is declared and is not related to the vehicle (weather, wildlife, range issues, etc) the vehicle should be treated under the hazardous cargo protocol. If the abort is related to the vehicle the air/spaceport should treat as an emergency*

*situation and follow procedures, many of which can be adopted from AC 150. An additional mitigation is a LOA with a nearby military base that has procedures for such scenarios.*

*For hybrid systems the carrier aircraft should not be considered a reusable launch vehicle or a vehicle performing a reentry as part of the larger operation. It is a transportation method and should be defined as such. The regulations should allow an applicant to designate a vehicle(s) orequipment that support a launch operation but do not fall in the same categorization as the vehicle performing the licensed operation.*

2) **What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on reentry safety?**

*Guidance regarding reentry risk assessment, landing location trade studies, reentry enable logic, vehicle reliability estimation based on vehicle architecture, test, and operator maturity, and landing area hazard area development and coordination with ATC and USCG for NOTAMs/NTMs. Advisory Circular 150: Airport Emergency Plan is an example of guidance that already exists but should be updated to account for additional elements addressed in this recommendation.*

3) **Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*The above recommendations cover an array of different topics but benefits include the following:*

*1) Consistent regulations across regulatory authorities add a level of consistency to operators no matter where they operate. This lowers cost and business uncertainty.*
*2) Benefits include reduced paperwork and reduced FAA/AST duplicative review of the same payload class.*
*3) The spaceport should be requirement to have adequate emergency procedures without placing an additional burden on the operator*

**<u>Other Aspects of Licensing</u>**

**The FAA seeks industry views on these other aspects of licensing:**

1) ***Application Process and Reporting Requirements.*** **A written application is the means by which the FAA determines whether a launch or reentry operator can conduct a launch or reentry safely. Once licensed, a licensee must provide to the FAA certain information prior to each launch.**

**a. How can the FAA modify its application process to improve efficiency for both the FAA and applicants?**

*Pre-application process is only required for new operators or new vehicle programs. For every other scenario, pre-application is at applicant's discretion and not mandatory. The existing process is described as being for the benefit of the applicant, yet many operators have experienced it being used as a means for preventing an applicant from having its application accepted to begin the official review process.*

*When the pre-application process is utilized, that process and the application process should have better continuity to create efficient and meaningful dialogue throughout the entire process. If an applicant submits a modification, the license should only be reviewed in the areas affected by the submitted modification.*

*The FAA should also develop a model application or framework that is available for applicants and use the pre-application process to identify what deliverables are required according to a level of rigor application. AST personnel involved in pre-application discussions should have extensive knowledge of the regulations and methods of compliance.*

*Regarding compliance with an issued license, information needed prior to each launch, as long as it is within the approved flight envelope, should be minimized and a centralized, automated system for submitting pre-flight information should be established. Continuing accuracy reviews should be limited to an assessment of the risks created by the change. If the regulations continue to use the term "material change," then that term should be defined in the regulations, guidance, or pre-application agreement.*

*For an operator's license, launch vehicle providers should be able to obtain the license with historical data and have the license be accelerated with an understanding that updated data will be provided for mission unique items. Eliminate all requirements for hard copies. FAA should accept government Range data directly from the Range and not have launch providers obtain data from Range to reformat it and send it to the FAA.*

*The pre-application process should be consolidated in Part 413 and the process should be modified to be less burdensome for experienced applicants. Other sections of Part 400 (§415.105) should be deleted and consolidated in §413.5. The various parts are not currently consistent. The process for dealing with an unacceptable application is defined in the regulations and should be followed. FAA-AST released a draft Advisory Circular (AC No. 413-5x, December XX, 2016) on Pre-Application Consultation that members of industry have reviewed and found to be no less burdensome than the current process. The "General Readiness Indicators" in Section 5.1 serve as an example of how the AC is too subjective.*

*Finally, the FAA should move to a performance-based process that is applicable to Parts 415, 417, 431 and 435 to enable improved efficiency for both the FAA and industry applicants.*

**i. How can the FAA modify its application acceptance process?**

*For sections §413.13 and §413.15, the FAA needs to establish a reasonable time frame for the "complete enough" determination. Without a defined timeframe, the lack of clear guidelines on this term: (1) reduces predictability in licensing process and can impact staffing and investment; and (2) can cause significant operational impacts. Multiple companies stated that no more than 15 business days should be provided to make a "complete enough" determination and provide feedback on whether the application is so incomplete or indefinite that the FAA cannot start to evaluate it. Application acceptance should not be withheld if review can be initiated for a single module or application subsection.*

**ii. How can the FAA modify its application review process?**

*The application review process should be modified to allow for incremental approvals of subsections to guide a focused review and avoid tolling. Rather than 180 days for review of an entire application, FAA should assign a brief period for each subsection or module. Further, the focus should be on process approval rather than approval of specific documents, data or other artifacts. We also suggest an audit approach rather than comprehensive evaluation process.*

*Post-licensing requirements should be streamlined and merged with licensing requirements to avoid confusion and reduce on-going burden. Post licensing should be focused on audit-style inspections and anomaly resolution (if public safety related). Continuing accuracy should be focused on change impact assessments to public safety rather than comprehensive updates to the application. This in-line with a process approval approach vs. artifact approval approach.*

*When making a change to a module, once it has been updated, it only needs to be updated once a change occurs and the brief review period begins again. The FAA should initiate a comprehensive review of the industry applicant's system safety processes at the start of the pre- consultation phase followed by appropriate auditing for compliance.*

*An applicant for a launch or reentry license should be able to identify one or more safety elements included in the applicant's license application and request concurrent review of those safety elements for a safety approval. That approach would eliminate the need for a duplicative, separate application for a safety review process that is assessing the same hardware, operation or process that is outlined in the license application. Granting safety approvals concurrent with licenses would allow a launch operator with multiple licenses or locations to amend the safety approval and have those changes apply uniformly across the*

*various licenses. It would relieve the need to submit individual license modifications for each license separately.*

**iii. How can industry modify what it submits to the FAA to minimize FAA's review time?**

*Submittals should be structured as a reasonable safety case that proposed actions are safe under all plausible scenarios. Submittals should focus on processes used to identify and control hazard, and verify sufficiency of controls. By highlighting key controls, the FAA can take a focused deep-dive approach to assessing soundness of the safety case.*

*Reviewing the applications by subsection or module where different elements of the license can be approved when ready for submission will provide companies with the ability to obtain early evaluation on higher risk items and perform more conscious risk reduction over time.*

**iv. How can the pre-application consultation process improve the efficiency of the application process?**

*Pre-application consultation should only be required for new operators or new vehicles, and pre-application requirements for experienced operators with new vehicles should be minimized to focus on identifying specific content of application that might be novel or different that the operators' prior submissions. Pre-application should have clearly defined entrance and exit criteria focused on determining operator experience, vehicle type and hazards, and public exposure to identify the applicable requirements and appropriate level of verification data required.*

**b. How can the FAA modify its reporting requirements to improve efficiency for both the FAA and licensees?**

*Reporting requirements and inspection activities should be limited to the scope of FAA's jurisdiction, which is protection of public safety and public property. Operators should report activities that are not governed by the oversight of another government regime (i.e., OSHA, ATF, or equivalent state regs) and that are so specific to space launch or reentry, and are hazardous to public safety as to warrant FAA AST's statutorily defined oversight. Further, a centralized, automated system should be established to facilitate dissemination of reported information to government entities who require the information.*

*For example, AST, ATO, and military entities who manage MTRs all require different preflight notifications on different time intervals. AST should be the repository of pre-flight reporting information and should disseminate that information accordingly by giving other US government entities access to a centralized system tracking such information.*

*Make reporting timelines consistent and predictable. Include timeframe for "complete enough" determination. Amend to require a determination that the application contains sufficient information to enable the FAA to initiate the reviews or evaluations rather than requiring that it be "sufficiently complete."*

**c. What is the industry's vision for a "File and Fly" regulatory framework?**

*By restructuring the regulation to focus on process approval, upon being granted an operator's license, an operator's obligations should be limited to filing a flight plan in the centralized, automated system, and verifying that its operations are in accordance with the processes described in its license application rather than on mission specific analyses, documentation, and broad notifications.*

*The key points for File & Fly are:*

1) *Vehicles will continue to become more reliable and fly more frequently;*
2) *Flight plans and trajectories will often be repeatable and standardized;*
3) *As (1) and (2) occur, the minimum notification times for various data should shrink; and*
4) *The regulations should not include firm timelines that will restrict the ability to move to a shorter "file & fly" approach; guidance should be used for timelines so updates can be made.*

*There were various timelines suggested related to file and fly by different companies. One company suggested that previously licensed launches provide 14-day notification for next flight and that any requirements prior to re-flight would be predefined during the licensing process. Another company provided input that the long-term goal should be 24 hours for a mission "flight plan." The company provided the following rationale for this position: ATO says they can manage their airspace plans and NOTAM dissemination with 24 hours' notice. AST and ATO currently have defined flight plan parameters that conform to ICAO flight plans for aircraft and can be ingested by their automation. Standardization of all flight data package data formats will enable more automated exchange and processing of all mission data. Hazard area calculations currently done by the Range may be done by the FAA or the operator in the future and can be exchanged easily in the same standardized format. Operators should be given access to FAA- developed NAS impact estimation tools to aid in mission planning – this would give the operator a way to measure and minimize NAS impact before submitting a flight plan.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*Implementing the above suggestions will result in significant cost savings and reduced personnel demands for license applicants. One estimate is that companies could reduce licensing staff for first new operator or new vehicle program by 20%, and reduce licensing staff by half after initial license is received to continue accuracy.*

*Defined timelines provide additional predictability in program scheduling and staffing plans that lead to or efficient business practices and cost savings. Finally, reduced FAA duplication of review process for already reviewed activity and reduction in complete enough determination timeline will drive efficiency into the process.*

**2) *Acceptable Means of Compliance.* Along with performance-based requirements, other guidance or standards must be developed or identified that would provide acceptable means of compliance. These can include FAA developed Advisory Circulars, industry developed voluntary consensus standards, and existing government or industry standards. Please provide industry views on the following:**

**a. What topics may be appropriate for a standards development organization to develop standards?**

1) *Risk Analysis (Ec)*
   a. *Acceptable analysis techniques*
   b. *A process for debris catalogue development*
   c. *Acceptable approaches to determining Pf for different types of operations d. Direction on selecting failure outcomes*
2) *Safety Critical System*
   a. *A process or procedure that documents an acceptable way to go through a system design and determine safety critical from an FAA perspective is needed. Many times, industry views safety critical more from a Mission Assurance point of view vs. public safety.*
3) *Sonic Boom*
   a. *Guidance on the required psf contours are to be reported in EA*
      i. *This will ensure that all applicants are providing equal data and being evaluated equally. The standard does not need to say what is a good psf or a bad psf, but what contours need to be reported so the evaluation is equal and consistent.*
4) *Table A417-3 Alternatives*
5) *Vehicle Reliability Assessment*
   a. *Using top-down, bottom-up, and hybrid approaches to account for both hardware failure and human error*

**b. What existing government and industry standards exist that would be appropriate to provide an acceptable means of compliance for some aspect of launch or reentry safety?**

*MIL-HDBK-516C (DOD AIRWORTHINESS CERTIFICATION CRITERIA) Part 25 (Airworthiness Standards: Transport Category Airplanes)*

*The following documents could all be simplified into digestible guidance:*

1) *Part 420 and 417 Appendices*
2) *NASA Risk Management Handbook*
3) *NASA System Safety Handbook*

*There is also a Flight Safety Analysis handbook that is published by the FAA that does not address some basic approach questions and often provides too much detail to be useful to a new vehicle operator. If this document was updated and edited it could present a clearer approach to an acceptable means of compliance for the risk assessment.*

**c. How can the FAA and industry work together to identify or develop acceptable means of compliance to performance-based requirements?**

*There is currently a committee under ASTM (F47 for Commercial Spaceflight) that is a good place to start. There is some participation currently from FAA but the process would be greatly enhanced if the FAA were able to dedicate more resources in that forum and take on more of a leadership role. This will help to ensure that both industry and FAA's views are incorporated into the standards that are developed.*

*The work that COMSTAC has done has already been considered within F47 and COMSTAC should continue to remain in close contact with the ASTM committee to ensure efficiency and consensus.*

*These partnerships should be used to provide input to FAA for development of Advisory Circulars or other guidance on a prioritized list of topics.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*Having clear expectations regarding compliance regulation would save time on the side of both industry and FAA. Oftentimes resources such as time, travel, and design rework are lost due to lack of clarity and understanding. If the guidelines and regulations were clearer, hundreds of hours on industry's side would be saved, as well as the time and effort required on the part of AST when reviewing the information provided to them. An estimate for each regulation that does not have a clear means of compliance costs industry on average 100 hours of labor at $200/hour (General Labor Rate for a mid-level engineer in this industry), resulting in a loss of $20,000. If that is multiplied by 50 - 100 items in the regulations, this results in a 1-2 million dollar impact to the applicant. A fraction of this time would be spent reading a guidance document detailing exactly what is needed. This document would not have to specify how to get there, but the end state necessary.*

**3) *Launch from a Federal Launch Range.* A significant number of commercial launches take place from a Federal launch range, overseen by the Federal agency that runs the range. The FAA partners with these Federal agencies to have common safety standards to the greatest extent practical.**

**a. How can FAA licensing of launches from Federal launch ranges be improved to improve efficiency?**

*Launch and reentry operators from industry developed a three-part consensus vision:*

1) *<u>End state for FAA licensed activities on a Federal Range</u>:*
   a) *DOT has sole authority of FAA Licensed flight safety activities*
   b) *The Federal Range has sole authority of ground safety activities outside the scope of licensed flight safety activities*
   c) *Federal Range and FAA have a common set of flight safety regulations*
   d) *The common regulations are based on the FAA performance based regulations that are currently in development as a result of the direction given by the National Space Council**
   e) *Both organizations develop a common set of guidance documents*

   **One company, while supporting the concept of common regulations, did not concur with this aspect of the desired end state*

2) *<u>Immediate steps that the government can take to reduce burden to commercial activities building to the end state</u>:*
   a) *Rewrite the MOA from 2001[1] to acknowledge the FAA's sole authority to license flight safety activities*
   b) *Put an agreement in place that allows both the current FAA regulations and the current Federal Range regulations to meet the intent of either organization's flight safety requirements*
   c) *The Federal Ranges should develop a common set of ground safety requirements based on modern industry standards*

3) *<u>End state definition of an FAA Licensed Activity</u>:*
   a) *FAA currently has the authority to license the following activities: Commercially procured launch and reentry activities including commercial missions and some DOD and NASA missions*
   b) *The membership of the ARC sees two options* for the future of FAA's licensing authority on Federal Ranges:*
      i) *Every launch and reentry activity becomes a FAA licensed activity except those by vehicles owned and operated by the government (e.g., SLS)***

[1] MEMORANDUM OF AGREEMENT BETWEEN DEPARTMENT OF THE AIR FORCE AND FEDERAL AVIATION ADMINISTRATION ON SAFETY FOR SPACE TRANSPORTATION AND RANGE ACTIVITIES

*ii) The FAA continues under its current authority, and Federal Range authority over non-FAA licensed activities uses the same flight safety regulations used by FAA for its licensing authority***

** One company did not concur with these two options*
*** The Federal Range has sole authority of ground safety activities outside the scope of licensed flight safety activities*

**b. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*History has provided many clear examples of the undesired cost and schedule impacts to commercial space operators from the current inefficient overlap of authority between two federal government organizations (FAA and federal ranges) during commercial space operations on a federal range. Industry believes the three-part vision articulated in our response to Question 1 will eliminate duplication of effort and lead to increased commercial operator flexibility, all while maintaining the high standard of public safety. These recommendations will enable industry's commercial launch and re-entry operators to be more efficient in the licensing process which promotes savings to customers and space operators alike. For example, at least one company estimates that more than a quarter of its licensing team's effort is consumed by dispositioning differences between Range and FAA requirements; the above proposal would alleviate the time and cost associated with that effort.*

**Additional Launch Safety Topics (Appendix)**

1) ***Hybrid Launch Vehicles.*** **A hybrid launch vehicle includes aviation-like components, such as a carrier aircraft or balloon. Parts 417 does not explicitly cover hybrid launch systems, and part 431 addresses them through the system safety process.**

*FAA AST should have procedures to license all phases of a hybrid launch system throughout the development lifecycle to give the Operator an option for a 'one-stop shop'. This would include for example: captive carry flights, drop tests, and launches. Additionally, AST should sanction the use of aircraft under experimental certificates when used in combination with AST launch licenses and adopt existing regulations for hybrid vehicles when they are flying like any other aircraft in the NAS. Ensure FAR91.319.a.2 "comp for hire" provisions do not preclude development of hybrid launch systems for scenarios when the launch service provider is not the owner of the aircraft.*

*Recommend improving the definition of safety requirements and level of detail the FAA wants to see from the launch provider to satisfy Part 431 Subpart C.*

**a. Please identify any cost-effective performance based regulations regarding hybrid launch vehicles.**

*Recommend that AST accept the airworthiness determinations made for the aircraft based on the FAA (AVS) issuance of the Airworthiness Certificate for the aircraft.*

*Recommend that for the "captive carry" portion of flight for Hybrid Systems, the use of already accepted flight safety rules aligned with expected impact of hazards be acceptable (e.g. Carrier Aircraft Hazards over open ocean).*

*Particularly for horizontal vehicles, one of the challenges is defining when "launch" takes place and subsequently when the flight safety analysis should begin. Currently, the regulations seem to define that launch begins when a vehicle is prepared for flight, rather than when the vehicle is within the launch window. Furthermore, a hybrid system that is performing an operation without the intent to launch is allowed to fly under an Experimental Airworthiness Certificate (EAC) or equivalent authorization and the impacts to public safety are considered during that certificating process. But when a hybrid system has an intent to launch, the operation is performed under a FAA-AST license which requires a flight safety analysis (Ec). Though the flight profile and configuration of the captive carry portion of the operation may be the same and of that conducted under the EAC, a different and more restrictive analysis is required. This points to a disconnect between the FAA's evaluation of public safety for the same operation. It is recommended that the flight safety analysis begin for a launch license at the moment the hazardous configuration of the hybrid system is different from that approved under an EAC or equivalent authorization. This would then meet the intent of protecting the public for licensed operations while also not setting different standards for the same operation under different authorities.*

*In addition, incorporating commercial air traffic in the calculation is unrealistic.*

**b. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations of hybrid launch vehicles?**

*Expand Flight Safety analysis handbook to include captive carry flight examples. Provide guidance around uncertainty expectations for mission segments that include piloted flight. For example, AST could require airworthiness standards or incorporate by reference to FAR 25/MIL-HDBK-516.*

*Recommend allowing the 431 Subpart C (Safety Review and Approval for Launch and Reentry of a Reusable Launch Vehicle) area to have procedures where the FAA is approving your internal processes and procedures, and verifying that you follow them.*

*Allow for AST and the Operator to define in their license when "launch" and "licensed activity" begins. For example, for Hybrid Systems the definition of "launch" could be the start of "pre-flight operations" or "pre-launch sequence."*

*Finally, for hybrid systems the carrier aircraft should not be considered a reusable launch vehicle.*

**c. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*Unknown/unclear regulatory jurisdiction complicates licensing. Government customers further complicate the regulatory landscape. Example: Captive carry flights, with no intent to launch, require experimental airworthiness certificate from AVS not AST. Providing both organizations of the FAA with necessary information is a duplication of effort.*

*If vehicle composition, flight path or launch window remain the same as a previous flight, reduce the application to new relevant flight information and save staff time on paperwork as well as AST processing time.*

**2) *Ground Safety.* Members of the public include uninvolved people outside the launch site, as well as visitors to the launch site. Pre-flight ground operations include hazardous operations on a launch site to prepare a launch vehicle for flight, and post-flight ground operations necessary to safe a returning launch vehicle component after landing.**

**a. What hazards to the public associated with pre-flight and post-flight ground operations should the FAA regulate?**

*The FAA should continue to regulate ground operations that may impact the public, but demonstration of compliance should be streamlined and flexible. 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.*

*The determination whether various ground operations are covered under regulations should be by means of a ground safety analysis using a combination of flight safety analysis methods, explosive siting methods, and other analytical approaches to define all hazards that cannot be contained within an area of controlled access. FAA should regulate only those activities not already regulated by other authorities.*

*Commercial spaceport licenses should require a plan and procedure to keep the public safe during operations. The Federal range or spaceport can then levy any requirements on the operator deemed necessary for use of that facility to remain compliant to the FAA's overall goal of maintaining public safety.*

*In cases where there is no separate site operator, such as uncontrolled US Government property or in international waters, the licensee should remain accountable to the FAA for compliance.*

**b. What current requirements related to ground safety should be retained as is, modified, or eliminated?**

*NFPA 780 is called out in Range requirements (i.e., DDESB6055.9) as the lightning protection standard to follow, but it was written for ordnance bunkers, etc., not to apply to structures such as launch pads. NASA was able to use a statistical approach for development of the LC39B LPS, but the USAF/DDESB does not acknowledge that method and requires adherence to NFPA780 requirements that don't make sense.*

*Commercial standards, OSHA, ASME, DOT, and NFPA (where appropriate), etc. are all used in commercial practice to great effect (e.g. PeroxyChem plant example). Just need to consider whether they should be modified to apply to space launch/reentry scenarios (such as NFPA 780 example above).*

*Definitions of third parties need to be aligned between the FAA, Air Force and other Federal ranges - currently multiple definitions exist (FAA is more conservative than Air Force) which require different calculations for USG vs commercial launch and landing activities.*

*"Public" should be defined as people and property not authorized by the Federal range, commercial spaceport operator, or space launch/reentry operator to be within the designated hazard area.*

*For hazardous operations, the range or spaceport may institute a more conservative safety zone to protect the hazard area, or may authorize 3rd party personnel and/or property to cross or stay within defined locations within the hazard area as defined based on targeted risk evaluation. The latter may be necessary to provide reasonable access to other operators conducting activities on collocated facilities. Authorization for a 3rd party to be within the hazard area during a period of elevated risk could be contingent upon the duration, required training, liability waivers, etc. Authorization of 3rd parties within the hazard area should be considered as mission-essential designation, excluding them from public risk requirements.*

**c. Please identify any cost-effective performance based regulations regarding the safety of pre-flight and post-flight ground operations.**

*Ground hazards should be controlled by safety clear zones defined using a hazard assessment*

*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.*

*The regulations should specify that if a launch or reentry site is in compliance with Part 420 or Part 433, respectively; then ground safety requirements apply under the site operating license, not the launch/reentry license. The launch/reentry license should reflect accordingly whether or not the licensee is directly responsible for compliance with FAA ground safety requirements.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on ground safety?**

*Part 417 Appendix J should be moved into a guidance document.*

*Quantity distance methods should be evaluated to align with the output of a hazard assessment. Consider IEC62305, which doesn't strictly apply to launch pads, but it does have different analytical methods with respect to very tall structures, or develop a standard written to address the unique attributes of a launch pad with a loaded LV.*

*For purposes of public risk assessment, likelihood of a hazard should reference existing FAA/Air Force range reliability standards based on test and operational experience with the system and by the operator.*

*Air Force and NASA standards can be adapted to be more performance based and applicable to different commercial sites. The key work here is "adapted" to be more performance based. Leveraging 91-710 and some of referenced standards would not be commercially friendly nor accomplish the goal of having a flexible regulatory structure.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**3) *Definition of Public Safety.* Currently, the FAA defines public safety as the safety of people and property that are not involved in supporting a launch, and includes those people and property that may be located within the boundary of a launch site, such as visitors, individuals providing goods or services not related to launch processing or flight, and any**

**other launch operator and its personnel (see § 401.5). This definition has proven to impact operations at launch sites with multiple launch operators.**

**a. Should the FAA revise this definition, or make other regulatory changes that would lessen the impact?**

**b. If yes, should the FAA exclude what the Air Force defines as "neighboring operations personnel," which are "individuals, not associated with the specific operation or launch or recovery currently being conducted, required to perform safety, security or critical tasks at the launch base or recovery site and who are notified of a neighboring hazardous operation and are either trained in mitigation techniques or accompanied by a properly trained escort" (see AFSPCMAN 91-710v1 § A5.2.3.3.2.)?**

**c. If FAA were to exclude neighboring operations personnel, the commercial operation may see increased financial responsibility obligations associated with the increased risk to third parties. How can this impact be mitigated?**

*Yes, industry has a broad consensus that the definition of "Public Safety" should be revised to more closely focus FAA's regulatory oversight on its statutory responsibility to "protect the public health and safety" cited in the purpose of Chapter 509. Industry believes there should be a distinction made clear between "the public" as is generally thought of as those uninvolved individuals located outside the controlled-access boundaries of a launch or reentry site or clustered sites within a defined federal or private spaceport. The following is offered as a revised definition that would re-define the FAA's focus on whom and what they are charged with protecting in reference to "public safety." The proposed definition:*

*"Public safety means, for a particular licensed launch or reentry, the safety of people and property that are uninvolved in the launch or reentry and are not permanently badged personnel of the licensed launch or reentry operator, or the licensed or federal site operator, or neighboring launch operations. Neighboring operations of other launch, reentry, or support personnel within the controlled-access boundaries of a multi-operator spaceport hosting two or more launch or reentry sites must be mitigated. The term "permanently badged" means a person identified and officially credentialed with a photo identification or equivalent for regular access to controlled-access areas by the licensed launch or reentry operator, a licensed site operator, their authorized support personnel, or a federal launch or reentry site operator."*

*The current FAA definition of "public" is overly broad, ambiguous, and inconsistent with that used by other federal agencies, including the USAF at the Cape. FAA Part §405.1 implicitly defines "public" as an element of the following:*

*Public safety means, for a particular licensed launch, the safety of people and property that are not involved in supporting the launch and includes those people and property that may be located within the boundary of a launch site, such as visitors, individuals providing goods*

*or services not related to launch processing or flight, and any other launch operator and its personnel.*

*This definition does not recognize that people, who work regularly within the controlled-access boundaries of a federal or private spaceport, or an operator's dedicated launch or reentry site, are not "public" in the normal sense of the word, but are industry workers who know and accept the hazardous environment in which they are employed. This does not require that these individuals be subjected to hazard risk levels above those specified for the public during a launch or reentry activity. Reference the Ground Operations section above for further information related to hazardous operations.*

*The rationale for the revised definition is that badged employees and contractors of operators on a multi user site accept that they are in a controlled industrial area with specific hazards present. They accept a personal responsibility for awareness of these hazards, compliance with employer and site occupational safety rules, and to engage in training as required. The proposed rewrite of the definition would identify everyone as a member of the public except for those identified by the definition. This would still allow for casual delivery vendors or tourists/visitors to remain classified as public.*

*As to mitigation for uninvolved neighboring operations personnel when a hazardous operation or launch is scheduled, measures might include: facility separation distances (e.g. separation between launch points on a multi-user spaceport) that anticipate and allow for safe concurrent operations; terms in site and use agreements with the federal or non-federal property owner that indemnify and hold harmless the Government or other landlord; potential reciprocal waivers (not required by regulation) that may be entered into among neighbors to share risks of hazards to each other's property and personnel. Local jurisdiction site or installation rules to limit personnel within hazardous zones.*

*The benefits of such a change would be to reduce regulatory burden and costs on both the operators and the FAA, while more clearly focusing limited FAA oversight resources on those activities and hazards that may reasonably expose "the public" to health and safety risks. Industrial safety standards adopted by the Occupational Health and Safety Administration (OSHA) could provide examples of standards industry is already obligated to comply with for its employees with respect to safe and healthy working environments.*

*In addition, at least one company voiced a desire to allow public spectators to attend a launch or reentry (via informed consent or assumed risk principles) without impacting the flight safety analysis calculations.*

4) ***Software Safety.*** **Modern launch vehicles employ extensive safety critical software, and software has become an increasing focus of FAA licensing. Part 417 has explicit requirements for computing systems and software. Under part 431, software safety is covered under the applicable system safety requirements.**

*General Comments on this topic:*
*1. Why is software safety explicitly called out for regulation when other aspects of vehicle design are not? E.g., FAA does not have structural engineers checking margins of safety and FEM models. FAA expects applicants to demonstrate adherence to industry standards, or best practices in other subsystem design; software should be the same. This area of review should be covered in an applicant's system safety approach. In general, the expectation that FAA review can adequately review flight code and provide any additional safety benefit is unlikely. The benefit resulting from this review does not outweigh the added time or cost.*

*2. If FAA continues to promulgate regulations focused on software safety, we recommend distinguishing between software safety requirements for safety-critical software (impacts to uninvolved public) vs. mission-critical safety software (e.g. mission control center operations).*

**a. What current requirements related to software safety should be retained as is, modified, or eliminated?**

*These requirements (like all undertaken in this effort) should take a Part 431/435 approach (rather than the Part 417 prescriptive approach) where software criticality is determined by means of a hazard analysis, and development rigor is scaled based on criticality.*

*Criticality should define the level of verification data required. The "AFSPCMAN91-712" (draft?) requirements that have been used for AFSS by the Air Force are not recommended for the following reasons:*

1) *Portions of the document seem to have been written to support delivery of software for Air Force systems (delivery of software to a customer), leaving a number of areas that require significant tailoring to be workable*
2) *Many requirements are overly prescriptive and do not always have a meaningful positive safety impact while driving costs to the developer (i.e. software language selection requirements that do not allow one to account for what the software team is familiar with)*
3) *Some prescriptive requirements, such as CMMI certification, are not feasible for all users and have already fallen out of favor for most government contracting.*

**b. Please identify any cost-effective performance based regulations regarding safety-critical software development and testing.**

*Using a system safety process to document the development and testing of safety critical software (e.g., in a Vehicle Test Report or equivalent) allows the level of rigor approach discussed in other sections, and allows flexibility of application for different vehicle*

*architectures allowing selection of the regulations applicable to each applicant and vehicle program. This is the cost- effective approach as compared to requiring every operator regardless of vehicle architecture or level of experience to prove the same prescriptive requirements.*

**c. What standards are available that would be suitable to demonstrate compliance with appropriate performance based regulations on software safety?**

*No response.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*In many cases, FAA's review, verification and analysis of software results in FAA duplicating the efforts of an applicant or an applicant's contractor. By vetting the process and methods used by the applicant to develop and test safety critical software (rather than independently analyzing/testing the code), FAA will reduce its staffing requirements and the process of approving applicant's submission will be more efficient (i.e., the applicant will not be responding to FAA inquiries as regarding why FAA's assessment doesn't match the applicant's testing and data).*

**5) *Mission Rules.* Launch safety rules (part 417) and mission rules (part 431) are used to govern the conduct of each launch.**

**a. What current requirements related to launch safety rules should be retained as is, modified, or eliminated?**

*Mission rules should be a direct output of the flight safety analysis and based on meeting the risk requirement vs. prescriptive requirements.*

*Part 417.113(d) Flight Termination Rules recommendations:*
*This section could be used as part of a guidance document, but is only one approach; keeping it as a requirement would limit future improvements and innovation, especially as the industry moves towards AFSS or alternative means of meeting risk requirements, which can open up more efficient means of improving safety and mission assurance when a human processing is not required.*

*1) Part 431 or future regulatory framework should be expanded to include the intent of the flight termination rules and reduce the chances of a user using a novel approach that misses out on the intent. Recommended:*
   *a. Violates limits or boundaries identified by the flight safety analysis*

i. *Vehicle is performing outside of its profile (mission trajectory, aerodynamic limits, and is unable to reach a useful orbit or survive) and needs to be terminated prior to overflight of a populated area (gate rules)*
ii. *Unintended and uncontrolled straight up flight that could spread debris over a large populated area (straight up rules)*

2) *Specific items within 417.133(d) that should be updated (assuming it is moved to guidance):*
   a. *Should be specified that the identified approach is one possible means of meeting the intent*
      i. *417.133(d)(3) should be removed or identified that it only applies to command destruct systems (not AFSS).*
   b. *"erratic" is not well defined and does not translate into meaningful AFSS rules*
      i. *"the potential exists for the loss of safety system control of the launch vehicle" has limited applicability to AFSS systems as major concern is the command uplink and the more extended RF receive system (antennas, coaxial cable, etc.)*
      ii. *All instances of "erratic" should be removed or revised to something quantifiable for AFSS use*
      iii. *As this moves to guidance, there is probably an opportunity to include other rules such as chevrons and vertical planes that are not required, but have proven to be a useful tool to reduce risk and make sure the flight safety analysis closes*

**b. Please identify any cost-effective performance based regulations regarding launch safety rules.**

*No non-government standards exist because this is a unique FTS application. Some value could be gained by documenting some of the Range-specific rules currently in use (including their intent and value), but this should be only for a guidance document with the understanding that it is simply a toolbox of options that may be used (as to avoid belief that the guidance methods are required and that novel options are discouraged/prohibited).*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on launch safety rules?**

*Especially for AFSS, the motion rules can be run in a Monte Carlo analysis that included dispersed and failure trajectories to demonstrate that the rules are sufficient to limit the impact to protected areas and limits identified by the flight safety analysis.*

**d. Should flight termination rules for autonomous flight safety systems differ from rules for traditional command destruct systems?**

*They should be allowed to; the first generation of AFSS systems started to mimic how a human MFCO would evaluate them but are starting to organically diverge, primarily because AFSS can evaluate data in a manner that a human cannot match.*

*As identified above, care should be taken in the requirements drafting to make sure that each requirement is something that can be quantified and avoid invocation of judgment. Words such as "erratic" are difficult (impossible) to translate into AFSS rules.*

**e. Should flight termination rules differ when using precomputed destruct criteria versus real-time destruct criteria?**

*They should be allowed to, yes; this should be based on the users' implementation and flight safety analysis. This area is in its infancy (of where it could go with AFSS) and it is probably impossible to write prescriptive rules today that will be effective and efficient as it evolves.*

**f. What measures of vehicle performance are useful in determining whether a flight is normal enough to be permitted to overfly protected areas when necessary to meet mission goals?**

*Traditionally, this has been a combination of altitude, velocity, and heading, but this is rather unimaginative and the optimal set will likely vary by vehicle. Ability to achieve orbit should be an overarching performance-based rule for orbital vehicles.*

**g. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**6) *Flight Hazard Areas.* Flight hazard areas are used to protect people, ships, and aircraft from launch vehicle hazards, and are often necessary to meet individual risk criterion.**

**a. What current requirements related to flight hazard areas should be retained as is, modified, or eliminated?**

**b. Please identify any cost-effective performance based regulations regarding flight hazard areas.**

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight hazard areas?**

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*The requirements FAA refers to in Question #1 are closely linked to the discussion of potential changes to flight safety analysis (see FAA Safety Topic 3 Flight Safety Analysis). Flight hazard areas should be a direct output of the flight safety analysis or MPL process and integrated with flight safety analysis guidance documents.*

*For both of these areas, industry needs a less prescriptive, more adaptable approach in order to achieve the efficiency necessary for significantly increased flight rates. Flight hazard areas should be risk based as opposed to containment based. FAA should accelerate capability for real-time air traffic management tools, particularly for periods following a mishap.*

*To the extent practical, the concept of having generic versions of pre-approved flight hazard zones "on the shelf" that can be cited as pre-approved by FAA for use by a particular vehicle version, on a predefined trajectory, would save enormous time and expense for repetitive launch (and reentry) review documentation and process. Industry recognizes that a suite of pre- approved hazard areas for predetermined trajectories may require real-time updating for dynamic weather conditions (e.g. winds aloft and conditions related to temperature inversions). Even these may possibly be captured in the "alternative envelopes" of otherwise standardized hazard area boundaries.*

*It may remain desirable for the FAA to offer alternative methods that an operator may utilize for developing an acceptable hazard area (such as the OEZ methods contained in Appendix A to Part 420). However, it is industry's consensus opinion these should be in a guidance document that are more readily adapted and evolved without revising regulations. The operator should also have the option to develop and use its own method, or that of a third party, to develop the boundaries of a flight hazard zone. If a federal range method is used, or contracted as a service, the FAA should accept that as an approved method without further burden on the operator to demonstrate compliance with an Ec standard. The proposed standard, regardless of method, should be defined in terms of individual risk criteria of 1E-06.*

*The FAA regulatory treatment of clearances within these zones should be governed by operator performance of diligent efforts and processes to ensure broad awareness and knowledge of the potential hazard, timeframes, and warnings appropriate to the hazards of a licensed activity. The standard for acceptable risk criteria for launch initiation (or reentry initiation) should be Ec. Risk-based analysis to meet this standard should be adaptable to evolving circumstances and protective/risk mitigation measures for the specific segments of a launch or reentry event. Streamlined regulations should assure consistency across federal, non-federal, and private ranges.*

*The FAA regulations associated with an operator's flight safety analysis and its resulting definition of flight hazard areas should be shaped by the FAA's statutory responsibility for assuring "the public safety and welfare" (Chapter 50901) in light of a more clear definition of*

*"Public Safety" as proposed by industry in response to the FAA Safety Topic soliciting industry input on the appropriate definition.*

*The measure of performance in providing "public safety" protection should be assurance that risk to the uninvolved public is within acceptable standards of Ec. The means of complying can vary and should be managed by the operator in accordance with a single license structure of FAA pre-approved operator procedures and processes.*

*This would allow for substantially reduced paperwork and review/approval cycles without compromising public safety standards or risk exposures, resulting in sizeable costs savings to both the industry operator and the FAA regulators. Moreover, this approach is essential to realizing the higher flight rates all stakeholders desire, and which are essential to meeting both commercial and Government mission demands.*

7) ***Unguided Suborbital Launch Vehicles.*** **Historical safety measures to ensure the safety of unguided suborbital launch vehicles are codified in part 417, primarily focused on wind weighting to isolate launch vehicle hazards from the public.**

    a. **What current requirements related to unguided suborbital launch vehicles should be retained as is, modified, or eliminated?**

    b. **Please identify any cost-effective performance based regulations regarding unguided suborbital launch vehicles.**

    c. **What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations of unguided suborbital launch vehicles?**

    d. **Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*This topic was not designated as an industry priority at the moment and no response was provided at this time.*

8) ***Induced Lightning.*** **Part 417 currently has strict weather constraints for launch in order to preclude hazards associated with induced lightning. The FAA would likely expect similar mitigation measures under part 431 stemming from the system safety process.**

    a. **What current requirements related to induced lightning protection should be retained as is, modified, or eliminated?**

*Current regulations, found in Appendix G of Part 417, should be modified to reflect the intent, or performance goal, of the stated requirements. Performance-based requirements should allow for consideration of each launcher's mission profile, general vehicle and flight safety*

*system components, and other factors that may reduce the current 30-minute constraint. The prescriptive requirements should be placed in a guidance document as an acceptable means of meeting the performance-based requirement.*

**b. Please identify any cost-effective performance based regulations regarding induced lightning protection.**

*No response.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on induced lightning protection?**

*Weather constraints defined in Appendix G of Part 417 should be moved into a guidance document that provides acceptable or suggested means of meeting triggered lightning requirements.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*Launch scrubs are extremely costly, and preventing no-go calls due to unnecessarily conservative weather restrictions could save launchers and site operators hundreds of thousands of dollars or more per instance.*

**9) *Crew Rest.* Both part 417 and part 431 include crew rest requirements for safety critical personnel – part 417 is performance-based and part 431 is prescriptive.**

**a. What criteria should be considered in determining for whom and under what circumstances rest requirements are necessary?**

*Crew rest rules should be applicable only to personnel with direct control of the vehicle or launch/reentry decision making and operators should make that determination. Similar to NASA's approach, the companies should be responsible for monitoring compliance. Regulations should require each license/permit applicant/operator to establish crew rest requirements applicable to their individual operation and AST would buy off on each operator's rules through the application review and approval process.*

**b. What current requirements related to crew rest should be retained as is, modified, or eliminated?**

*Remove 431/435. Retain 417 approach and modify as explained in answer to question a. above and as explained here. The Part 431/435 rule is nebulous even though it is prescriptive. For example, the "VSOP" definition is unhelpful and inconsistently implemented across industry leading to differences of opinion between AST Licensing and Inspection staff*

*as to whom the rules should apply. Part 417.113 should be basis of new requirement. This allows for greater flexibility in ensuring safety critical personnel are allowed enough rest. Requirements should be applicable only over the period during which a mistake could manifest as an impact to public safety.*

*An example of where this approach works in industry: NASA astronauts do not have crew rest standards but their rest/work periods are closely monitored by NASA and adjusted as required. Aerospace employees in manufacturing plants and mission control staff do not have mandated requirements.*

*(see:https://www.ncbi.nlm.nih.gov/books/NBK216189/table/ttt00019/?report=objectonly).*

**c. Please identify any cost-effective performance based regulations regarding crew rest.**

*Prescriptive regulation can be counterproductive, and adds safety risk for small businesses. Particularly for small business, some industry respondents feel that any regulation is over- regulation because regulation in this case will actually drive greater safety risk as those companies will hire temps to do work the experts should be doing.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on crew rest?**

*No response.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*The current Part 431 rule is similar to those rules exercised by Federal Range authorities for launch activities at Federal Ranges. This are not appropriate for vehicle programs that are smaller scale or less complex that orbital launch vehicle programs. By applying a part 431-type rule to these types of smaller programs, you drive additional and unnecessary staffing needs. Additional benefits for a small company include not having to hire additional resources that are often less capable and inherently less safe since they do not work the systems daily.*

**10) *Safety Organization and Personnel Qualifications.* Parts 417 and 431 include requirements for a safety organization and a safety official. Part 417 includes specific requirements for personnel qualifications.**

**a. What current requirements related to safety organization and personnel qualifications should be retained as is, modified, or eliminated?**

*There are many requirements that may not accurately reflect an applicant's safety organization. Rather than implemented specific titles and qualifications, the regulation should*

*define the goal: ensuring applicant has a structure in place to ensure public safety. The more prescriptive requirements of 417 and 431.33 should be moved to guidance. Specific recommendations include removing direct reporting structure of "Safety Official" and the requirements to name the Safety Official by name (qualifications should be sufficient). Naming the Safety Official and of lines of communication can be part of the inspection process. For personnel qualifications, FAA may use the current requirements as guidelines for evaluation and approval when necessary.*

**b. Please identify any cost-effective performance based regulations regarding safety organization and personnel qualifications.**

*No response.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on safety organization and personnel qualifications?**

*No response.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**11) *Safety Directive.* Part 431 requires an applicant to list and consolidate mission constraints, rules, and certain procedures in a safety directive or notebook. Part 417 has similar requirements.**

**a. What current requirements related to a safety directive should be retained as is, modified, or eliminated?**

*We generally recommend no changes to this approach. Parts 431.39 and 431.41 should be retained and crew rest rules specific to the operator should be documented in the safety directive.*

**b. Please identify any cost-effective performance based regulations to replace these prescriptive requirements.**

*No response.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations?**

*No response.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**12) *Agreements.* Parts 417, 431, and 435 require a launch operator to enter into agreements with entities such as the U.S. Coast Guard, FAA Air Traffic, and Federal launch ranges.**

**a. What current requirements related to agreements should be retained as is, modified, or eliminated?**

*Industry generally agreed that with respect to Air Traffic Centers, the agreements required under 431.75 should remain until tools are made available to effectively integrate space launch and reentry activities into the National Air Space. Industry also generally agreed with respect to US Coast Guard and Range activities, the agreements should remain except that for providers operating entirely in existing ranges; e.g. Restricted Areas, no LOAs with the surrounding ARTCCs should be required because there is already an agreement between the ranges and the adjoining Centers (ARTCC) so to have a separate LOA with the ARTCC is not needed since the operation does not affect the ARTCC.*

*Implement reasonable time limits for the period that each agency has to review, comment, and sign Letters of Agreements (LOAs). This should be standard practice that does not take extended periods of time. The agreements process could also be benefited by making FAA AST the primary point of contact for the licensee with respect to obtaining such LOAs. A consistent interface within the different agencies would make the process more efficient and more consistently applied to various operators and in instances of agency personnel turnover.*

*An alternative view was presented by one company where LOAs would be eliminated and moved to the safety checklist and to the pre-application process. The following basis was provided for this position:*

*431.75(b) requires an "agreement between the licensee and the local U.S. Coast Guard district to establish procedures for the issuance of a Notice to Mariners prior to a launch or reentry and other measures as the Coast Guard deems necessary to protect public health and safety." Issuing Notice to Mariners (NTM) or other tool the Coast Guard (CG) may use in the future is important, however, to require a formal agreement when the CG already has a process/procedure for the issuing of NTMs is putting a requirement on another government organization when the FAA does not have that authority. To demonstrate compliance, place it on the safety checklist.*

*431.75 (b) also requires an "agreement between the licensee and the FAA regional office having jurisdiction over the airspace through which a launch and reentry will take place, to establish procedures for the issuance of a Notice to Airmen prior to the conduct of a licensed launch or reentry and for closing of air routes during the respective launch and reentry windows and other measures deemed necessary by the FAA regional office in order to protect public health and safety." This regulation is too generic, the only requirement is the issuing of NOTAMS, then go on to include 'any other measure…' and it should be with the 'appropriate FAA ATO office/facility.' Since reorganization, the Regional Office has little to do with the ATO, and they are talking about another re-organization. Should remain generic. These LOAs become difficult to negotiate, and are at times inconsistent with the LOA required for Launch Site Operators (LSO). Suggest that the LSO requirement be removed and covered in the pre-application consultation. Then define operational specifics to be included under 431.75 in any agreement with FAA's ATO, such as real time mission coordination, notification, routes etc. To cover all licensed launches specifics in a LOA is almost impossible, the LOA should cover timelines for mission specific coordination. Language of section will require ATO input.*

**b. Please identify any cost-effective performance based regulations regarding agreements.**

*No response.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on agreements?**

*The FAA should establish LOA templates for the various government agencies. This would keep formatting and content consistent across various providers and ultimately allow the agency to quickly assess the information and clearly define and obtain the required information.*

**d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*The approach outlined above, including: (1) reasonable time limits for review, comment, and approval; (2) FAA AST as the primary point of contact; and (3) the establishment of LOA templates will provide for a predictable approach to LOA development. These recommendations will drive consistency and will make the process more efficient and cost effective.*

**13) *Launch Plans.* Part 417 requires a launch operator to have 11 plans, as follows:**

- **Flight safety plan.**
- **Ground safety plan.**
- **Launch support equipment and instrumentation plan.**
- **Configuration management and control plan.**
- **Frequency management plan.**
- **Flight termination system electronic piece parts program plan.**

- **Accident investigation plan.**
- **Local agreements and public coordination plans.**
- **Hazard area surveillance and clearance plan.**
- **Communications plan.**
- **Countdown plan.**

**a. Should the FAA require launch plans in general?**

**b. How should this rulemaking otherwise address the safety goals that these plans address?**

**c. Please identify any cost-effective performance based regulations regarding the safety goals that these launch plans address.**

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering the safety topics within these launch plans?**

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible, especially regarding changes to paperwork and recordkeeping requirements.**

*Yes, the FAA could accept a baseline set of launch plans (if and as long as FAA is licensing authority) as a means of complying with a performance-based licensing regime. However, the current highly prescriptive content of the 11 plans identified in 417 is far more detailed than necessary to assure the protection of the "public health and safety" in industry's view. In light of other recommendations to streamline the licensing process and to re-focus the FAA oversight based on a re-definition of "public safety" it is recommended that FAA scale back the required content of the plans to what is necessary to meet that responsibility. Launch plans should be distilled down to their intent rather than requiring specific items such as a piece parts program plan.*

*These plans should become part of a baseline license covering a vehicle version for many launches from one or more sites that rely on pre-approved modules of safety documentation and procedures. The current regulatory timeframes and requirements for submission of changes is onerous and untenable for high flight rates. There should be some significant reduction of content to focus on what is really important to assure protection of public health and safety, together with reasonable requirements for notifications and amended procedures documentation to the FAA. These should only be required for plan changes that could alter the level of safety to the point of jeopardizing compliance with Ec requirements.*

*Any other lesser changes should be required to keep documentation up-to-date and for information only to the FAA, subject to the operator providing additional explanation if required and such amendments should not preclude or delay the operator's conduct of launches or reentries under their license.*

*The FAA should streamline Launch Plans (and reentry plans for that matter) to incorporate a tailored, streamlined set into each operator's baseline license for a vehicle version, or even a family of vehicle variants of similar size and operational characteristics, which differ primarily in performance, payload capacity, or similar parameter (e.g. the family of Falcon 9s, Atlas Vs,*
*Antares, New Shepard). Such baseline plans supporting a multi-year, multi-site license would be unlikely to change dramatically, especially in regard to the components affecting the responsibility to assure public safety.*

*But such an approach would vastly reduce unnecessary paperwork and eliminate the unrealistic and untenable deadlines in current regulations, timeframes that are burdensome and potentially prohibitive to achieving higher rates of flights.*

**14) *Reviews.* Part 417 requires a hazardous operations safety readiness review, launch safety review, and a launch readiness review. Part 431 requires a mission readiness review.**

**a. How can this rulemaking preserve the level of safety accomplished by these reviews?**

*It would be useful if the FAA could distill the required reviews down to their intent rather than require specific reviews. In particular, it is advisable that the agency list the minimum items that they want to see reviewed and then the operator could inform them in the license application where to find them and how they would be reported.*

**b. What current requirements related to reviews should be retained as is, modified, or eliminated?**

*No response.*

**c. Please identify any cost-effective performance based regulations regarding reviews.**

*No response.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering reviews?**

*No response.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**15) *Rehearsals.* Part 417 requires a countdown rehearsal, emergency response rehearsal, and a communications rehearsal. Part 431 requires dress rehearsal procedures.**

**a. How should this rulemaking address these requirements?**

*The coming rulemaking should address current inconsistencies between license requirements and establish baseline requirements. Distill the required rehearsals down to their intent (e.g., exercising changes to ops procedures, training crew) rather than require specific rehearsals. Once an operator is operating frequently, operators may not need to conduct rehearsals (and we will likely not have time to do this either) when launch/reentering real operations frequently.*

**b. What current requirements related to rehearsals should be retained as is, modified, or eliminated?**

*Current Part 431 requirements are generally the right approach.*

**c. Please identify any cost-effective performance based regulations regarding rehearsals.**

*No response.*

**d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering rehearsals?**

*No response.*

**e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*No response.*

**16) *Mishaps.* Things can go wrong during launch operations, ranging from a minor anomaly to an accident in which public property is damaged or casualties occur.**

**a. Should the FAA modify the current mishap definitions and the investigations that are required? If so, what modifications should be made?**

*Mishap definition should:*

1. *Change "Launch Site Accident" to "Launch/Recovery Site Accident"*
2. *Add definition for "Launch Site Incident" that includes incidents during pre- and post-launch activities such as roll-out of a launch vehicle to the pad, payload integration, configuration for launch, wet dress rehearsal or hot fire. The definition should also include incidents occurring at the launch site as a result of launch (such as fire, toxic release or shock) that impact public safety, property or the environment.*
3. *Add definition for "Recovery Site Incident" that includes incidents at landing and during*

*post-landing securing and deservicing activities that impact public safety, property or the environment.*

*"Failure to complete a launch or reentry as planned" is too broad and does not recognize the differences between operational missions and higher risk experimental/test missions.*

1. *Test programs covered under experimental permits may be undercut since concerns over protracted mishap investigations discourage robust testing that may push the limits of a vehicle. A higher threshold than completing a test "as planned" should be met before triggering an investigation under an experimental permit.*
2. *For operational missions, this portion of the definition should be focused on mission events and performance related to license terms vs. simply launch or reentry. Such a definition would include conditions such as "failure to deliver a payload to the intended orbit."*

*Reporting requirements for mishaps not involving fatality or serious injury are unclear and left up to the operator. The FAA should define a minimum standard for a "reportable" mishap, in addition to a minimum set of investigation/reporting requirements including information to be provided at initial notification.*

*The $25,000 damage figure is outdated (Air Force and NASA policies use double that amount). The definition of mishap and the resulting investigation should have a clear tie to the FAA's public safety role, and the damage figure has the consequence of requiring reporting and investigation of incidents that don't affect safety risk but result in damage to expensive hardware.*

1. *Some companies believe monetary value should not be a mishap criterion, but that mishap reporting/investigation requirements should be based on public safety risk.*

2. *Other companies believe unintended investigations can be mitigated through exclusion of licensee-owned property in the damage assessment, while liability for other property damage remains relevant to financial responsibility requirements outlined in Part 440.*

**b. Please identify any cost-effective performance based regulations regarding mishaps.**

*The approach defined above will limit the number of formal mishap reviews while better aligning mishap investigations to FAA objectives.*

*FAA/NTSB accident investigations should be streamlined to leverage licensee investigation efforts rather than the operator conducting an internal investigation in parallel with cooperating on a separate Government investigation. For mishaps that meet the minimum*

*reporting threshold, the FAA, NTSB, or other designated Government entity (e.g., Federal Range) should be integrated with the licensee investigation, as appropriate, with the Government having full insight into investigation data, involvement in proceedings, and approval authority for investigation findings.*

*Rather than having the operator's Accident Investigation Plan address detailed mishap investigation procedures that cover a wide range of potential mishap scenarios, the Cooperation with the FAA and NTSB requirement should be expanded to include that the operator will consult with the FAA on the full scope of investigation requirements specific to the mishap. This would enhance flexibility and reduce the burden of developing extensive detailed procedures.*

**c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering mishaps?**

*The FAA should draft guidance that includes recommendations for information that an operator provides the government for public release to promote transparency and sharing of lessons learned. That could include information on deaths or serious injuries, estimates of damage to Government and private property (other than the operator's property), direct and root causes for the mishap, and government requirements for return to flight approval.*

*Reference NASA/DOD mishap reporting standards.*

*A minimum set of data should be defined for public release by the Government, including deaths or serious injuries, estimates of damage to Government and private property (other than the operator's property), direct and root causes for the mishap, and government requirements for return to flight approval. This transparency is necessary to assure the public that safety is being appropriately addressed, and provides lessons learned across industry to prevent future mishaps that may have been avoidable.*

d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

*No response.*

**17) *Policy and Payload Reviews.* In addition to launch and reentry safety, FAA licensing addresses national security and foreign policy interests of the United States (policy issues) and authorization of payloads not otherwise regulated or owned by the U.S. government.**

**a. What current requirements related to policy and payload reviews should be retained as is, modified, or eliminated?**

**b. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.**

*In general, FAA should conduct Payload reviews, however, the reviews being conducted are far more detailed than necessary to assure the protection of the "public health and safety" in industry's view. Payloads that stay within the vehicle, are of non-hazardous materials, or those that have previously been approved for flight should not require review. The safety goals can be met by only requiring reviews for hazardous payloads could impact "public health and safety".*

*It would be more cost-effective to only regulate hazardous payload classes that are ejected from the launch vehicle in reportable quantities.*

*Existing standards would require any payload that exceeds the limits set forth in 49 CFR § 172.101 Hazardous Materials Table and Passenger aircraft/rail quantity limits would be applied to manned vehicles and Cargo aircraft only limits applied for unmanned vehicles.*

*Such an approach would vastly reduce unnecessary paperwork and subsequent FAA review for "benign payloads". Reducing the burden on the FAA to review "non safety related payloads" would support industry increased flight tempo and reduced review times.*

*Proposed regulation additions to address potential review exemptions:*

1) *Recommended to add the following exceptions to 14 CFR §431.57:*
    a. *(h) Payload reviews are exempt if they are not ejected from the launch vehicle.*
    b. *(i) Payloads that do not contain hazardous material as defined in section 49 CFR § 172.101 Hazardous Materials Table above "Quantity limitations" should qualify for licensee certification as (non-hazardous) and be eligible for "file and fly" (Cargo aircraft only limits applied for unmanned vehicles).*
    c. *(j) A payload that has previously received an FAA/AST approval for launch, would be "file and fly" eligible", if it has not gone through any material change on earth or in orbit that could potentially affect public safety and it is not co-manifested with other non-compatible payloads.*
    d. *(k) Payloads that contain hazardous materials in federally reportable quantities will be reviewed in 15 days.*

*The FAA should eliminate reviews if captive or non-hazardous payloads to focus on those payloads that provide a measurable level of risk beyond that already considered in the launch vehicle risk profile. Such an approach would vastly reduce unnecessary paperwork and help reduce review timeframes that are burdensome and potentially prohibitive to achieving higher rates of flights.*

## 4.2. Follow-up Question Responses

After the ARC submitted its responses to FAA's initial set of questions, the Agency sent the ARC a set of follow-up questions. Those questions, and the ARC's responses to them (in italics), are reproduced below in their entirety.

1) **Page 3, System Safety, Question (a). The ARC states that the system safety process should form the core of the FAA requirements.**

   ***Follow-up Question:*** **Does the ARC recommend that the system safety process be required for all launch and reentry scenarios and all flight phases, or would other safety approaches be acceptable in some circumstances? If so, please elaborate.**

*Yes, the assessment of an applicant's system safety process should be required for all launch and reentry scenarios and all flight phases. A process for identifying hazards under all scenarios and flight phases that determines severity and identifies appropriate hazard control and verification strategies is the current best practice to ensure a comprehensive safety case. However, there should be flexibility in control strategies. For example, a vehicle operating in an unpopulated area, contained by physics, may not need any other controls beyond ensuring that the operating area is sufficiently sized, and that public access is restricted. See the recommended approach attached (in Appendix D), "Building a Safety Case for FAA Licensing Purposes."*

2) **Page 4, System Safety, Question (e). The ARC states that the FAA should initiate a comprehensive review of an applicant's system safety processes at the start of the pre-application consultation phase to define the appropriate level of rigor for that applicant or vehicle program.**

   ***Follow-up Questions:***

   a) **What data should the applicant provide the FAA for this purpose?**

*The applicant should provide a complete description of their hazard identification and control process in a document such as a System Safety Program Plan or equivalent. The applicant should also provide a system-level PHA or FHA, a summary of company history, a summary of vehicle heritage and any applicable flight history, a description of populated areas potentially affected by vehicle operations, and a complete description of all inert, explosive, and toxic hazards associated with the vehicle design. The applicant should include a description of how each of these pieces of data or outputs is used in the overall system safety process. An applicant should also describe how they audit this process.*

**b) How could the requirements be written to avoid the need for extensive negotiations between the FAA and applicant, like is currently required today under 14 CFR part 431?**

*Recommend developing a licensing requirements matrix following a structure similar to NASA's "Launch Vehicle Certification Requirements Matrix" in NPD 8610.7D in order to make vehicle and operator categorization explicit. See the recommended approach attached, "Building a Safety Case for FAA Licensing Purposes." Determination of vehicle and operator categorization should be the primary purpose of pre-application consultation. Additionally, System Safety Plan required content should include the factors that AST currently evaluates when determining the appropriate level of rigor.*

**3) <u>Page 5, Flight Safety Systems, Question (b)(ii)</u>. The ARC states that the variables that go into a flight safety analysis should be used to determine what the required reliability of an FSS should**
**be.**

***Follow-up Question:*** **How should an applicant demonstrate the reliability of a flight safety system that does not otherwise meet RCC-319 like standards?**

*3 different approaches that are valid (including the RCC 319 option mentioned in the question):*

- *Systems with previous qualification to RCC319/AFSPCMAN91-710/Part 417 and approved for use at a major launch site, are usable at any launch site without further testing as long as the environments are encompassed by the existing qualification and there are no range-specific environments (EMI/EMC exposure, salt fog, etc.) that were not covered by the original qualification.*
- *This should apply to systems that have been previously approved for use on vehicles at KSC, CCAFS, VAFB, and Wallops, additional review may be required for other launch sites that may have different requirements due to geographic or other considerations.*
- *While focused on heritage systems, this path should remain open for any user that prefers to follow the existing style of requirements for new or revised systems.*
- *For heritage systems with extensive flight experience (i.e. flight of > 50 units), demonstrated flight/operational reliability, when combined with a bottom's up reliability analysis, and a streamlined qualification to the predicted environments should provide sufficient confidence in heritage systems. This approach is aimed for using units, such as the HFTR-60 receivers which are regularly used on any number of atmospheric and space launches. Qualification testing should be performed on a single unit per SMC-S-016 or an equivalent standard (including thermal, vibration, and shock testing) to ensure that the unit is suitable for the intended environments; EMI/EMC testing also should be performed per MIL-STD-461, but this will often be satisfied by previously conducted testing. (Still mulling over how much of the heritage system would need to be implemented on a new vehicle for the new vehicle to benefit from the reduced single unit qual test approach.)*

*<u>Additional comments from one company</u>: Qualification testing…on a single unit per SMC-S-016 or an equivalent standard…" These standards are for general vehicle testing and don't consider the higher reliability required for flight safety systems. Additional margin and certainty are required per RCC319/AFSPCMAN91-710. A single unit in this case is also not sufficient, unless there was a tradeoff that increased the required test margin. For automated flight safety systems, software testing should be conducted for code updates, mission data loads, and configuration changes that could impact system performance.*

- *For new systems without extensive heritage, following of, still to be developed, performance based guidance documentation.*

**4) <u>Pages 5 and 6, Flight Safety Systems, Questions (a) and (b)</u>. The ARC states that a flight safety system should not be required; instead, an operator should be required to meet the allowed risk calculations in the Flight Safety Analysis, and that the current expected casualty requirements would be an appropriate performance for flight safety.**

***Follow-up Question*: A flight safety system is typically used to meet collective Ec and individual risk criteria and to prevent low probability, high consequence events to the public. Given the uncertainties associated with the inputs (e.g., probability of failure) of a flight safety analysis, how does the ARC propose an operator protect against low probability, high consequence events without a flight safety system?**

- *The point of the regulation is to allow for such means should they be developed in the future. That said, there are multiple means of risk mitigation. Flight path (not flying over populated areas); debris containment; flight termination; thrust termination; flight pedigree (where reliability data proves that it's actually more hazardous to have ordnance attached). Vehicles could utilize the flight computer to recognize boundaries and trigger existing vehicle systems to take safety measures.*
  *Keep in mind that ordnance may also have an additive effect on commercial spaceflight risk.*
- *Recommend the operator have an adequate sample size to support the allowed risk calculations in the Flight Safety Analysis.*

- *There does not need to be a dedicated FSS in the traditional sense that follows the requirements for a traditional system. Any vehicle that is capable of creating low probability, high consequence events to the public should still include protections and mitigations driven by the systems safety approach to vehicle design. The intent is to provide flexibility in the implementation, but examples include propellant dumping, flight health monitoring, or operational mitigations.*

- *Additional comments from one company:*

1. *Disagree that flight health monitoring is a protective measure. Knowing vehicle health does not in itself reduce risk, but requires an FSS or other means of positive control to achieve risk reduction.*
2. *An FSS is a control for a high consequence event and should therefore be required when vehicle performance capabilities make such an event physically possible and other controls do not ensure dual failure tolerance (consistent with current flight safety standards) for the applicable hazards. In the case of human spaceflight, a controls methodology would be implemented to avoid a conflict between the safety of vehicle occupants and the general public. Determination of the need and type of FSS should be based on analysis of vehicle failure modes that could impact public safety, and risk to the public utilizing the proposed method(s) of risk mitigation.*

**5) Pages 6 - 7, Flight Safety System, Question (c). The ARC states that the FAA should scale required verification requirements by vehicle and operator category and relative risk. Categories could include new vehicle by new operator, proven vehicle by experienced operator, derived vehicle by experienced operator, vehicle hazard class, and sparsely or densely populated areas.**

***Follow-up Question:*** **What would the ARC recommend as appropriate metrics and thresholds to establish and distinguish between classes of operator experience, vehicle hazard, and public exposure?**

- *Number of flights; flight performance data; flight profiles; vehicle components and materials.*
- *Recommend that an operator that was using an established system safety process that the FAA had already approved would not need to start from scratch getting that process approved for a subsequent vehicle.*

- *Three successful flights should distinguish an experienced operator from a new operator, vehicle casualty area greater than X should determine vehicle hazard class (where X is based on a potential mass casualty event), and public exposure should be based on probability of impact to a populated area (1E-04 to 1E-06) as a baseline and population density (establish categories from 1 to 100,000 persons per square mile). Alternatively, identify a specific threshold for vehicle size, mass, or TNT equivalency and to differentiate between orbital and suborbital vehicles.*

**6) Page 7, Flight Safety Analysis, Question (a). The ARC states that because health monitoring and a decision to proceed precedes the overflight phase of flight, that phase of flight should get a separate risk budget from the prior phase of flight.**

**Follow-up Question: Is this the correct interpretation? Currently, the FAA combines launch area and overflight risk into one risk budget.**

*FAA is interpreting correctly. Following the logic used in reentry, where a decision to proceed to reentry allows for a separate risk budget, the intent is to give credit for successful phases of flight, and to make proceeding through an overflight gate an explicit decision, even more so than it is now. The theory is that the launch area risk is one budget, and when launch has occurred and the vehicle has progressed through an abort gate (i.e., no abort was undertaken because the vehicle is performing safely enough to proceed to overflight of a land mass), then another risk budget should apply because the vehicle's performance has passed the scrutiny required to move from one phase of flight to another. Furthermore, there is the potential in the future that systems will exist that have several phases of fight that require health and monitoring through different phases of flight and have decision gates that take into account that current health of the vehicle before proceeding to the next phase. The recommendation is that each of the phases that are preceded by health and monitoring, and pass a decision gate to continue flight, be allocated separate risk budgets. To ensure equitable risk mitigation for all licensees, the number of phases should be dictate by the CONOPS of the proposed operation, but each risk budget should have the same criteria and based on the same risk limit as today's regulations. The recommendation would change the FAA's current baseline of combining launch area and overflight risk.*

*At least one company did not concur with statements regarding separate risk budgets. Passing through a gate does not necessarily retire risk for the remainder of flight, but deems the residual risk acceptable. During flight, there is no explicit go/no-go decision that can avoid a failure during a subsequent overflight phase. Unless a flight safety system or other method of real time control is employed to provide a safer alternative, the vehicle is not under positive control and cannot avoid the risk. Therefore the launch or reentry risk budget should not be divided nor additional risk budget be allocated for separate phases.*

7) **<u>Page 11, Flight Safety Analysis, Question (f)</u>. The ARC states that specifying a required level of fidelity and providing guidance for each level of fidelity should reduce iterations on analyses by at least 30%, resulting in reduced FTE costs devoted to licensing processes.**

   ***Follow-up Question:*** **Please clarify how a 30% reduction of analyses was derived.**

*Several companies believe that by establishing fidelity expectations in regulations and in guidance, time spent iterating on flight safety analysis products before they are accepted by FAA (in terms of approved tools, methods, and inputs) can be reduced significantly. The reduction of analyses was estimated at 30% based on one company's recorded attempts to achieve acceptance of their FSA product by FAA (acceptance in this case required 5 iterations of the FSA, 4+ hours of telecons supported by 2-3 company employees and numerous FAA officials). With specific guidance as to what would have been acceptable to FAA from the outset, the company believes the telecons could have been reduced to one or two hours, and iterations on the FSA products would likely have been reduced from 5 to 2-3 iterations. We thought a 50% estimated reduction was high, since the estimate reflects input from only one company, and so we made the estimate more conservative.*

8) **<u>Page 18, Application Process and Reporting Requirements, Question (a)(ii)</u>. The ARC states that the application review process should be modified to allow for incremental approvals of subsections to guide a focused review and avoid tolling.**

***Follow-up Question:*** **How would such an incremental approval process work? How would it fit within the FAA's statutory requirement to make a determination on a license application within**
**180 days?**

*With respect to the FAA's additional questions on the Application Process and Reporting, the ARC submits the following response. First, it is incorrect to assume that the existing 180-day review period would remain in the new regulations. Second, a license would be comprised of various modules with a required review period for each module that would be much shorter than 180 days (suggestion is 30 days per module). Module submittals could be provided to the FAA in serial or parallel in the order of the applicant's choosing. Extra time would be provided for FAA review if several modules are submitted in parallel. Third, Updates would only be required for modules that are different than previous licensed applications and the FAA would accept previous module submittals where there was no change from previous licensed applications. Finally, when the FAA completes its review of a module, the FAA must notify the user if the module is adequate or not. If there are issues resolving any module deficiencies, prompt notification with a sufficient level of detail must be provided to ensure timely resolution of the issue.*

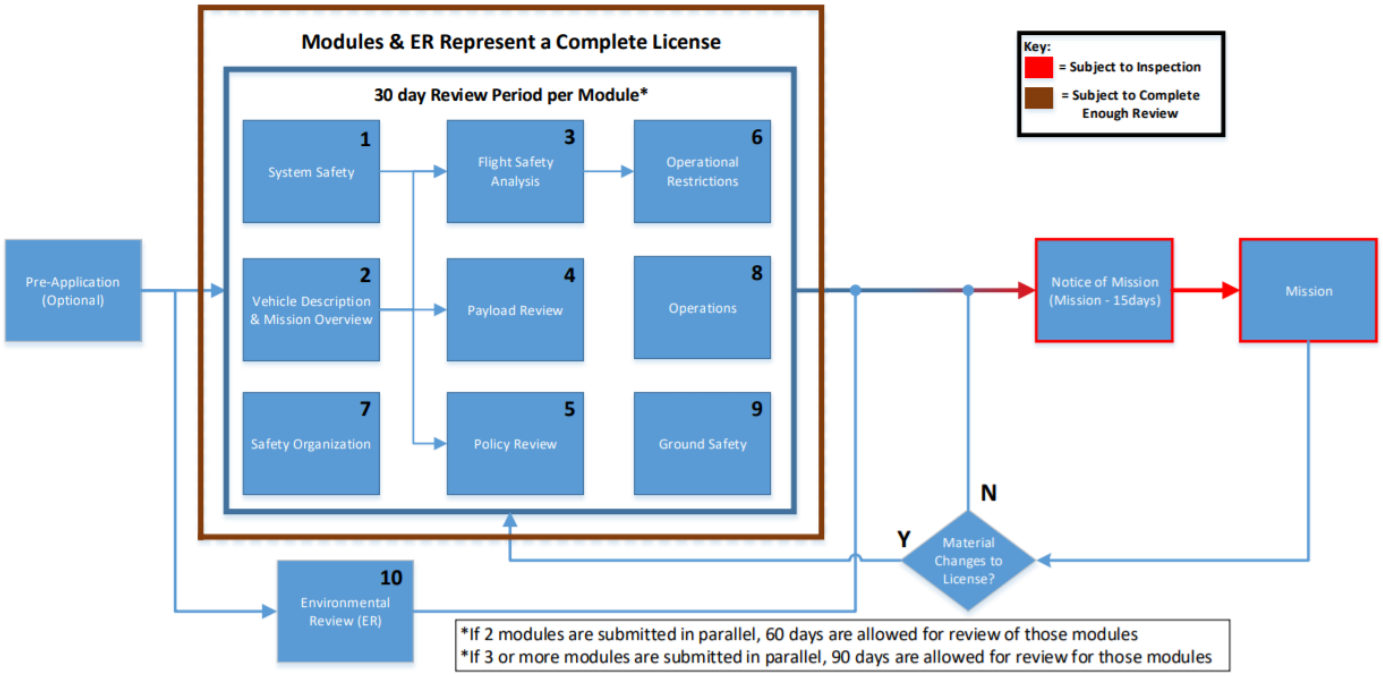
*Additionally, the following provides a list of guiding principles and a process flow, which would help to establish proposed regulatory framework that meets the current level of safety while offering more flexibility in the licensing process. Focusing on the following framework will result in initial and recurring safety and economic benefits through increased flexibility, reduced paperwork burden, and an expansion of commercial activities.*

1) *Performance Based*
   a) *Measure of performance Ec*
   b) *Means of complying can vary and left up to operator*
2) *Flexibility*
   a) *Single license structure to accommodate a variety of vehicle types and operations and launch/reentry sites*
   b) *Allow for coordinated determination of applicable regulations prior to application submission*
   c) *Ability to meet regulations without waivers*
   d) *Use Guidance Documents to facilitate frequent updates*
3) *Reform Pre Application Process and Requirements*
   a) *"Complete Enough" is the real criteria for entering application evaluation*
   b) *Completion of a pre-app process is not a requirement for application acceptance or complete enough determination*

c) *Experience vs inexperienced; known vs unknown vehicles*

4) *Defined review timelines*
   a) *Restructured rules support shorter, more efficient review*
   b) *Increased predictability for industry*
   c) *For new and continuing accuracy submissions*
   d) *Existing timelines significantly reduced*
5) *Continuing Accuracy requirements*
   a) *Based on public safety impact based on Ec*
6) *FAA Jurisdiction*
   a) *Limited to activities so publicly hazardous as to warrant FAA's oversight*
   b) *Well defined inspection criteria*
7) *Eliminate Duplicative Jurisdiction on Federal Ranges*
   a) *References in rules to Range jurisdiction*
   b) *NSpC recommendation to revise licensing regime in coordination with members of NSpC*

*A modular approach helps to meet the National Space Council's objective of having a performance based and streamlined regulatory framework for commercial launch and reentry licenses. This approach maintains the core elements of licenses today while enabling faster evaluation times and the ability to receive partial evaluation early in vehicle development as a method of risk reduction for applicants. The figure below depicts a flow diagram of the proposed regulatory framework from the initial engagement with AST through flying multiple missions under an issued license.*



*The process begins with an optional pre-application phase. Pre-application should be optional to an applicant as they may be experienced in license applications or hire-in expertise that does not require pre-application. Overall, pre-application is viewed as an optional risk mitigation that an applicant can use to prevent any unforeseen items in the complete enough review. AST retains the "complete enough" determination to prevent inadequate applications from proceeding to the consideration process, and AST should use this gate to provide substantive feedback to applicants whose application packages are insufficient.*

*The core of the license application is broken into 9 modules. The modules are independent in terms of content, when possible, to allow applicants to submit modules for evaluation as they see fit for the program. Some modules will necessarily depend on others, thus there is an order of operations indicated by arrows between some of the modules. Each module when submitted will go through a complete enough review that has a 7 day deadline for AST determination. Once accepted as complete enough, each module has a 30 day review period. The applicant has the option to submit the modules in series or parallel; whichever best fits the applicant's development plans and risk posture. Due to some of the dependencies between modules, the AST review periods are scaled per the following:*

- *If 2 modules are submitted in parallel, 60 days are allowed for review of those modules*
- *If 3 or more modules are submitted in parallel, 90 days are allowed for review of the modules*

*It should be noted that due to the NEPA process for submitting and evaluating an environmental assessment, a separate module outside of the core 9 modules is represented on the flow chart. AST should work with other federal agencies to better define and limit the review period on the EA process to make the total licensing effort more efficient.*

*Once all of the modules have been deemed complete enough and reviews are completed with a positive determination issued, a license is granted to the applicant. The license will be valid for 5 years, under which an infinite number of operations can occur that meet the conditions of the granted license application. The items in red on the flow chart indicate where inspections would occur in order to demonstrate compliance with the issued license and continuing accuracy. Only "material changes" (a new defined term) require the licensee to submit amended application materials to FAA and warrant an update to the license. These changes would be accessible by inspectors during those periods leading up to and through a licensed activity.*

*Leading up to a license activity a Notice of Mission is issued at mission minus 15 days. This is where items identified in the Notice of Mission Plan, as defined in the license, would be completed/delivered to AST. Once the mission is completed, an operator can conduct other missions following the same process as long as the conditions of the License still apply. When an operator wants to add capability or make a modification to the License, only the affected modules need to be submitted for reevaluation. Once those have been approved by AST,*

*missions utilizing the updated conditions can be executed. Any time a module is being updated or revaluated, operations can still occur under the bounds of the existing, issued license.*

9) **<u>Page 26, Hybrid Launch Vehicles, Question (b)</u>. The ARC recommends that AST and the Operator be allowed to define in the license when "launch" and "licensed activity" begins. The ARC further suggests that for Hybrid Systems the definition of "launch" could be the start of "pre-flight operations" or pre-launch sequence.**

***Follow-up Questions*:**

a) **What pre-flight operations does the ARC believe should trigger the beginning of licensed activities? In other words, what pre-flight operations are inherently so hazardous as to warrant the FAA's regulatory oversight?**

*Recommend licensed activities for all vehicles (not limited to Hybrids) include (i) pre-flight ground operations, (ii) flight operations, and (iii) launch operations phases as tailored by each launch operator (e.g. all three phases may not be applicable for all launch operators). Recommend the initiation and scope of launch licensed activities, pre-flight ground operations, and flight operation phases be defined by the impact of each activity on public safety and property risk. This may comprise both hazardous and safety-critical operations, the latter encompassing non-hazardous activities that may impact public risk during other pre-launch and flight activities. A list of performance-based criteria for licensed activities would be tailored for each operator and AST based on their specific concept of operations. This scope should only include hazardous operations not already regulated by another government agency unique to activities as defined in the operator's license application documents.*

b) **Does the ARC believe that beginning of launch should be closely proximate in time to flight?**

*The definition of launch should be defined by each vehicle operator (not limited to Hybrid operators) and AST (see answer to a) above).*

10) **<u>Page 30, Definition of Public Safety, Question (a)</u>. The ARC recommends that permanently badged personnel on a launch or reentry site not be considered "public."**

***Follow-up Question*: For the Air Force, neighboring operations personnel (NOP) are individuals, not associated with the specific operation or launch currently being conducted, but are required to perform safety, security, or critical tasks at the launch base, and who are notified of a neighboring hazardous operation and are either trained in mitigation techniques or accompanied by a properly trained escort. The NOP may include individuals performing launch processing tasks for another launch, but do not include individuals in training for any job or individuals performing routine activities such as administrative, maintenance, support, or janitorial. NASA has a similar definition for NOP as the Air Force, but refers to them as Critical Operations Personnel. Some trainees, administrative, maintenance, support, and janitorial**

**personnel on a site are likely to be permanently badged. Should these individuals be considered "public"? If not, why?**

*When the FAA asked industry whether there should be a revised definition of "Public Safety" as it currently exists in §401.5, industry representatives reviewed FAA's statutory charge from Congress codified in Chapter 509. Industry considered how FAA has interpreted that charge as reflected in the current definition of "public safety" in the regulations. Industry does not believe it was constrained to only consider the FAA example of Neighboring Operations Personnel (NOP) as currently defined in policy (not regulation) by the Air Force. The consensus of industry was that the definition contained in regulations should be revised to align with the statutory responsibility, and focus FAA's regulatory oversight on its statutory responsibility to "protect the public health and safety" cited in the purpose of Chapter 509. Industry believes the current definition inappropriately extends the function of protecting "public safety" to issues more accurately characterized as "industrial safety" for those who work within the controlled boundaries of launch and reentry sites/spaceports. Personnel that are permanently badged, or similarly credentialed for access to controlled areas, are trained in the nature of the hazards which are or may be present, and/or properly escorted by trained personnel. They are not the public. Both hazard and non-hazard areas should be managed and controlled by the host installation (federal or commercial spaceport) and by the launch operators on the site to facilitate both workforce safety and site security. They can accomplish those objectives without a need for FAA regulatory prescription and oversight. Industry believes it is FAA's statutory role to protect public health and safety, not to regulate industrial ground safety for personnel that work at launch and reentry sites.*

**11) Page 31, Definition of Public Safety, Question (c). As a mitigation for uninvolved neighboring operations personnel when a hazardous operation or launch is scheduled, the ARC suggested that potential reciprocal waivers may be entered into among neighbors to share risks of hazards to each other's property and personnel.**

***Follow-up Question:*** **Does the ARC believe that FAA insurance requirements would then not need to apply to neighboring operations personnel?**

*The FAA specifically excluded Part 440 Financial Responsibility from the scope of this ARC. There are many questions industry has previously presented to FAA for clarification of Part 440. Among those are the appropriate role of non-regulated insurance and risk-sharing arrangements entered into between operators, and between operators and their host site. In general, without being able to assess the FAA's response to those questions, this follow-up question must be answered in the context of a notional regulatory regime in which operators are free to indemnify one another, and their host site operator/land owner via*

*cross waivers or assumption of risks agreements. These would represent an explicit acceptance of the identified risks of a neighboring operation/launch. In the absence of such an agreement, the neighboring operators would comply with the applicable safety-clear rules of the site operator. In this scenario, operations personnel of an uninvolved operator remaining in the hazard area of a neighboring or nearby operator would not be considered in the safety criteria for initiating a launch, criteria intended to ensure an acceptable level of safety to the uninvolved public. These people would not be included in the MPL calculation driving financial responsibility requirements under Part 440. Property owned by neighboring operators, if not encumbered with third party stakeholders/owners, would also be excluded from FAA-regulated and required insurance IF the property is also covered by operator-to-operator and operator-to-host site allocation of risk agreements.*

**12) Page 31, Definition of Public Safety, Question (c). The ARC states that the benefits of excluding permanently badged personnel from the definition of public would be to reduce regulatory burden and costs on both the operators and the FAA.**

***Follow-up Questions*:**

**A limited amount of provider-specific data was made available to respond to the following questions, but based on that input we offer the following examples:**

**a) What costs do you incur when another operator conducts a launch?**

*Removal of uninstalled property such as construction equipment, trucks, and heavy equipment; we move personnel, and then we lose days of work and progress on major construction projects or on day to day operations at fully functioning facilities.*

**b) Do you have to vacate your employees from your facility?**

*Yes. We currently evacuate at L-4 hours and able to return at L+1 hour.*

**c) How many employees must vacate?**

*The cost of a 4 hour window plus return time result in a cost impact estimated at $300K-$500K per launch/landing attempt based on projected employee load (average of 450 workers on site for construction projects). During recurring operations, the number required to evacuate will be in the 125-150 range. We believe an initial step in reducing clear times can be accomplished without impacting safety and can save significant expense while these rules are being debated and finalized.*

**d) Do these employees work remotely?**

*No. During construction, up to a 4-year endeavor for new launch or landing facilities, workers can only perform their jobs while on the launch site. During recurring ops, about half of the team can work remotely leaving about 75 workers inactive for 6-8 hrs per attempt (average wage $45/hr)*

**e) Of these employees, what percentage of them are engineers, security personnel, administrative personnel, etc.?**

*During major construction activities, the large majority are engineers, technicians (perhaps 1-2 administrative and 1-2 security). During recurring operations the ratio does not change a noticeable amount.*

**f) How much productive time per employee is lost?**

*For a typical mission involving a landing under the current rules, 6-8 hours are lost per launch/landing attempt.*

**g) Are there other costs aside from those related to lost time or employee productivity?**

*Additional costs include the time to secure operations prior to evacuation as well as spin up time once access to the site is authorized post mission. This includes securing vehicles and equipment and activating remote monitoring systems. Impact is an additional 20-25 personnel for 3 hours prior and 3 hours after the clear.*

**h) If so, what information can you give us about those costs (quantified and monetized, if possible)?**

*For the cost impact of an additional 20-25 personnel for 3 hours prior and 3 hours after the clear, assume average wage of $45/hr)*

*In addition to this industry example given above, in discussions with the Navy Leadership at CCAFS, they have indicated that evacuating what is identified as the "Special Clear Area" as directed by the 45$^{th}$ SW results in the Navy losing 1.5 man-years of production for each evacuation. The nominal evacuation impacts approximately 500 employees.*

**13) Page 35, Flight Hazard Areas. The ARC states that flight hazard areas should be risk based as opposed to containment based. The ARC further recommends that the FAA accelerate the capability for real-time air traffic management tools, particularly for periods following a mishap.**

***Follow-up Question*: Real-time air traffic management tools require the FAA to receive real-time state vector and other information from the launch or reentry operator. Is industry able to provide this information to the FAA in a cost-effective manner?**

*Operators can provide real-real time state vector information to support the real-time air traffic management but there concerns over the use of the information, protection of proprietary information and cost impacts for operators who do not have this capability built into their architecture. Some operators already are providing this data in real time during launch and reentry operations to FAA's Tech Center in New Jersey. Industry has discussed operators providing real-time state vector and other information in meetings of the "Airspace Access ARC". Those discussions included the need to define the information required from the operators and the format required for submission, as well as an understanding of how the tools functioned and the information would be used and highlighted the need for the FAA to protect corporate proprietary information and demonstrate how the FAA would protect the information.*

**14) Page 39, Safety Organization and Personnel Qualifications, Question (a). The ARC recommends that the FAA remove the direct reporting structure of the Safety Official.**

***Follow-up Question:* The direct reporting structure of the Safety Official is designed to ensure that safety concerns are addressed independently of mission assurance and that those concerns are conveyed to the person in charge of licensed launches. Does the ARC recommend an alternative means to provide safety independence?**

- *New wording, which can be added during our re-writing meetings, should replace "direct report" with "direct line of communication." A direct reporting structure is not necessary to ensure public safety and the intent can be met by various organizational arrangements.*

- *Recommend no change in the current Safety Official direct reporting structure. Direct reporting of the safety official does not induce any burden for an operator with a functional safety culture.*

## 5. OTHER RECOMMENDATIONS AND CONSIDERATIONS

During the course of the ARC, a Task Group was formed to provide draft regulatory text and/or proposed revisions to existing regulations. While all industry participants of the ARC were invited to participate, many companies were not able to due to the extremely short timetable imposed and attendant bandwidth restrictions. The volunteer industry members of the Task Group were Blue Origin, Sierra Nevada Corporation, Space Florida and SpaceX.

This task group was formed to fulfill a request by Acting Administrator Elwell and to further address the first and second tasks called out in the charter. These responses are supplemental to what is contained in Section 5 and serve to provide concrete examples of the sometimes abstract concepts expressed in those responses.

The output from the Task Group can be found in Appendix E. It should NOT be construed to represent consensus of industry; the members of the ARC have reflected their concurrence on this work in Appendix F. Moreover, the Task Group intends for the content of Appendix E to be an early step in progressing towards the regulatory content in a new rule set. Draft rule language is included to explain how the Task Group has considered translating the ARC's answers to FAA's specific questions into rule language. Given the time available to focus on both this task as well as the answers to FAA's questions, the content in Appendix E is understandably not comprehensive or intended to be final. Rather, it is intended to be an early step in continuing discussions about the appropriate content of a new, performance-based rule set in light of the larger ARC responses to FAA's specific questions.

# 6. APPENDIX

## Appendix A – ARC Membership List

| | |
|---|---|
| 1 | Aerospace Industries Association* |
| 2 | Airlines for America |
| 3 | Alaska Aerospace Corporation (AAC) |
| 4 | Astra Space** |
| 5 | Blue Origin |
| 6 | Boeing |
| 7 | Coalition for Deep Space Exploration (CDSE) |
| 8 | Commercial Spaceflight Federation |
| 9 | Exos Aerospace Systems & Technologies, Inc. |
| 10 | Generation Orbit |
| 11 | Lockheed Martin Corporation |
| 12 | MLA Space, LLC |
| 13 | Mojave Air and Spaceport |
| 14 | Orbital ATK |
| 15 | RocketLab* |
| 16 | Sierra Nevada Corp. |
| 17 | Spaceport America* |
| 18 | Space Exploration Technologies, Corp. (SpaceX) |
| 19 | Space Florida |
| 20 | Stratolaunch |
| 21 | United Launch Alliance (ULA) |
| 22 | Vector Launch, Inc. |
| 23 | Virgin Galactic/Virgin Orbit |
| 24 | World View Enterprises |

*Organization was invited by FAA to be a member of the ARC, but did not substantively participate.

**Organization participated in the ARC, but did not submit a completed voting template.

## Appendix B – FAA Initial Questions

**Questions for the Streamlined Launch and Reentry Licensing Requirements Aviation Rulemaking Committee**

Answers to the following questions will assist the FAA in developing proposed regulations and accompanying guidance material. The questions are divided into four areas: scope, launch safety, reentry safety, and other aspects of licensing. The ARC should concentrate on those areas believed by industry to be most critical.

The FAA relies on economic data to successfully develop and publish a proposed rule. The ARC should provide quantitative data and information on the impacts of its recommendations when practical. For each recommendation, identify potential initial (one-time) or recurring benefits in terms of safety, flexibility, paperwork burden relief, cost savings or enabling economic benefits (how it would expand commercial activities). In addition, identify potential initial or recurring costs in terms of paperwork burden, training, operations and maintenance, or capital costs. If the benefit, savings or cost is minimal, then identify as such and provide a basis why. If quantitative information is not available, then provide a qualitative description and basis of the expected benefits, savings and costs for each recommendation.

Scope of the Rulemaking:

The scope of the rulemaking is the licensing of launch and reentry activities, involving expendable and reusable, orbital and suborbital, crewed and uncrewed, guided and unguided, and conventional and hybrid launch and reentry vehicles. The FAA plans to focus on cost-effective public safety-related regulations. The FAA does not intend to address the following in this rulemaking: financial responsibility, orbital debris mitigation, licensing of the operation of launch and reentry sites, and experimental permits.

1) *Scope.* What aspects of launch and reentry licensing should the FAA address in this rulemaking?

Launch Safety:

The commercial launch industry is extremely diverse. Measures used to protect public safety during a launch depend on a number of factors, including whether the launch vehicle is guided or unguided, whether the launch vehicle is orbital or suborbital, whether the launch vehicle is hybrid or conventional, where the launch takes place, the explosive potential of the launch vehicle, whether the launch vehicle contains toxic propellants, and others. Ideally, the consequences of a launch vehicle failure should dictate the level of rigor that a launch operator should apply to system safety, flight safety systems, flight safety analysis, etc. The level of rigor of FAA's application evaluation could vary in a similar manner.

The FAA seeks industry recommendations on the safety topics listed below. The Appendix includes additional launch safety topics that the ARC may address if time permits. Each response should provide justification, and should be comprehensive enough to address the diversity of current and future operations. Because the FAA regulates launches only to the extent necessary to protect public health and safety, safety of property, and the national security and foreign policy interests of the United States, industry should identify why each recommendation is necessary to achieve this mandate.

1) *System Safety.* Parts 431 and 435 are primarily process-based, relying on an applicant to derive safety requirements through a system safety process. Part 417 is less reliant on system safety.
    a. To what extent should the FAA require a launch operator to conduct a system safety process in order to derive safety requirements for its launches?
    b. What current requirements related to system safety should be retained as is, modified, or eliminated?
    c. Please identify any cost-effective performance based regulations regarding system safety.
    d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on system safety?
    e. How should the FAA apply a level of rigor concept to system safety?
    f. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

2) *Flight Safety Systems.* A flight safety system is often used for a launch to meet collective and individual risk criteria. It is also used in a launch area to prevent low probability, high consequence events. Current design and testing requirements in part 417 ensure that the flight safety system is highly reliable. Part 417 does not, however, cover autonomous flight safety systems explicitly.
    a. What current requirements related to flight safety systems should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations regarding flight safety systems. Recommendations should include:
        i. When should a launch vehicle be required to have a flight safety system?
        ii. What should determine the flight safety system's necessary reliability, and how should a launch operator demonstrate it?
        iii. What other safety mitigations are available to prevent low probability, high consequence events?
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight safety systems?
    d. How should the FAA apply a level of rigor concept to flight safety systems?

e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

3) *Flight Safety Analysis.* A number of quantitative analyses are used to demonstrate that a launch will meet collective and individual risk criteria, as well as to determine aircraft hazard areas, ship hazard areas, destruct lines, etc.
   a. What current requirements related to flight safety analysis should be retained as is, modified, or eliminated?
   b. Please identify any cost-effective performance based regulations regarding flight safety analysis.
   c. Is there an alternative to flight safety analysis that would provide an equivalent level of safety?
   d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight safety analysis?
   e. How should the FAA apply a level of rigor concept to flight safety analysis?
   f. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

4) *Maintenance and Reuse.* Current regulations address the maintenance and reuse of launch vehicle components and vehicles through the system safety process.
   a. What current requirements related to maintenance and reuse should be retained as is, modified, or eliminated?
   b. Please identify any cost-effective performance based regulations regarding maintenance and reuse.
   c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on maintenance and reuse?
   d. How should the FAA apply a level of rigor concept to maintenance and reuse?
   e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

<u>Reentry and Landing Safety</u>:

Many of the issues discussed under launch safety apply to reentry as well. Currently, the safety of reentries is primarily achieved through an applicant implementing a system safety process to derive and verify mitigation measures, and quantitative risk analyses.

1) Please identify any cost-effective performance based regulations regarding reentry safety.

2) What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on reentry safety?
3) Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

Other Aspects of Licensing

The FAA seeks industry views on these other aspects of licensing:

1) *Application Process and Reporting Requirements.* A written application is the means by which the FAA determines whether a launch or reentry operator can conduct a launch or reentry safely. Once licensed, a licensee must provide to the FAA certain information prior to each launch.
    a. How can the FAA modify its application process to improve efficiency for both the FAA and applicants?
        i. How can the FAA modify its application acceptance process?
        ii. How can the FAA modify its application review process?
        iii. How can industry modify what it submits to the FAA to minimize FAA's review time?
        iv. How can the pre-application consultation process improve the efficiency of the application process?
    b. How can the FAA modify its reporting requirements to improve efficiency for both the FAA and licensees?
    c. What is the industry's vision for a "File and Fly" regulatory framework?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

2) *Acceptable Means of Compliance.* Along with performance-based requirements, other guidance or standards must be developed or identified that would provide acceptable means of compliance. These can include FAA developed Advisory Circulars, industry developed voluntary consensus standards, and existing government or industry standards. Please provide industry views on the following:
    a. What topics may be appropriate for a standards development organization to develop standards?
    b. What existing government and industry standards exist that would be appropriate to provide an acceptable means of compliance for some aspect of launch or reentry safety?
    c. How can the FAA and industry work together to identify or develop acceptable means of compliance to performance-based requirements?

d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

3) *Launch from a Federal Launch Range.* A significant number of commercial launches take place from a Federal launch range, overseen by the Federal agency that runs the range. The FAA partners with these Federal agencies to have common safety standards to the greatest extent practical.
   a. How can FAA licensing of launches from Federal launch ranges be improved to improve efficiency?
   b. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

## Appendix
## Additional Launch Safety Topics

1) *Hybrid Launch Vehicles.* A hybrid launch vehicle includes aviation-like components, such as a carrier aircraft or balloon. Parts 417 does not explicitly cover hybrid launch systems, and part 431 addresses them through the system safety process.
    a. Please identify any cost-effective performance based regulations regarding hybrid launch vehicles.
    b. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations of hybrid launch vehicles?
    c. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

2) *Ground Safety.* Members of the public include uninvolved people outside the launch site, as well as visitors to the launch site. Pre-flight ground operations include hazardous operations on a launch site to prepare a launch vehicle for flight, and post-flight ground operations necessary to safe a returning launch vehicle component after landing.
    a. What hazards to the public associated with pre-flight and post-flight ground operations should the FAA regulate?
    b. What current requirements related to ground safety should be retained as is, modified, or eliminated?
    c. Please identify any cost-effective performance based regulations regarding the safety of pre-flight and post-flight ground operations.
    d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on ground safety?
    e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

3) *Definition of Public Safety.* Currently, the FAA defines public safety as the safety of people and property that are not involved in supporting a launch, and includes those people and property that may be located within the boundary of a launch site, such as visitors, individuals providing goods or services not related to launch processing or flight, and any other launch operator and its personnel (see § 401.5). This definition has proven to impact operations at launch sites with multiple launch operators.
    a. Should the FAA revise this definition, or make other regulatory changes that would lessen the impact?
    b. If yes, should the FAA exclude what the Air Force defines as "neighboring operations personnel," which are "individuals, not associated with the specific operation or launch or recovery currently being conducted, required to perform

safety, security or critical tasks at the launch base or recovery site and who are notified of a neighboring hazardous operation and are either trained in mitigation techniques or accompanied by a properly trained escort" (see AFSPCMAN 91-710v1 § A5.2.3.3.2.)?

c. If FAA were to exclude neighboring operations personnel, the commercial operation may see increased financial responsibility obligations associated with the increased risk to third parties. How can this impact be mitigated?

4) *Software Safety.* Modern launch vehicles employ extensive safety critical software, and software has become an increasing focus of FAA licensing. Part 417 has explicit requirements for computing systems and software. Under part 431, software safety is covered under the applicable system safety requirements.
   a. What current requirements related to software safety should be retained as is, modified, or eliminated?
   b. Please identify any cost-effective performance based regulations regarding safety-critical software development and testing.
   c. What standards are available that would be suitable to demonstrate compliance with appropriate performance based regulations on software safety?
   d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

5) *Mission Rules.* Launch safety rules (part 417) and mission rules (part 431) are used to govern the conduct of each launch.
   a. What current requirements related to launch safety rules should be retained as is, modified, or eliminated?
   b. Please identify any cost-effective performance based regulations regarding launch safety rules.
   c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on launch safety rules?
   d. Should flight termination rules for autonomous flight safety systems differ from rules for traditional command destruct systems?
   e. Should flight termination rules differ when using precomputed destruct criteria versus real-time destruct criteria?
   f. What measures of vehicle performance are useful in determining whether a flight is normal enough to be permitted to overfly protected areas when necessary to meet mission goals?
   g. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

6) *Flight Hazard Areas.* Flight hazard areas are used to protect people, ships, and aircraft from launch vehicle hazards, and are often necessary to meet individual risk criterion.
    a. What current requirements related to flight hazard areas should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations regarding flight hazard areas.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on flight hazard areas?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

7) *Unguided Suborbital Launch Vehicles.* Historical safety measures to ensure the safety of unguided suborbital launch vehicles are codified in part 417, primarily focused on wind weighting to isolate launch vehicle hazards from the public.
    a. What current requirements related to unguided suborbital launch vehicles should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations regarding unguided suborbital launch vehicles.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations of unguided suborbital launch vehicles?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

8) *Induced Lightning.* Part 417 currently has strict weather constraints for launch in order to preclude hazards associated with induced lightning. The FAA would likely expect similar mitigation measures under part 431 stemming from the system safety process.
    a. What current requirements related to induced lightning protection should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations regarding induced lightning protection.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on induced lightning protection?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

9) *Crew Rest.* Both part 417 and part 431 include crew rest requirements for safety critical personnel – part 417 is performance-based and part 431 is prescriptive.

a. What criteria should be considered in determining for whom and under what circumstances rest requirements are necessary?
b. What current requirements related to crew rest should be retained as is, modified, or eliminated?
c. Please identify any cost-effective performance based regulations regarding crew rest.
d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on crew rest?
e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

10) *Safety Organization and Personnel Qualifications.* Parts 417 and 431 include requirements for a safety organization and a safety official. Part 417 includes specific requirements for personnel qualifications.
    a. What current requirements related to safety organization and personnel qualifications should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations regarding safety organization and personnel qualifications.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on safety organization and personnel qualifications?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

11) *Safety Directive.* Part 431 requires an applicant to list and consolidate mission constraints, rules, and certain procedures in a safety directive or notebook. Part 417 has similar requirements.
    a. What current requirements related to a safety directive should be retained as is, modified, or eliminated?
    b. Please identify any cost-effective performance based regulations to replace these prescriptive requirements.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

12) *Agreements.* Parts 417 and 431 require a launch operator to enter into agreements with entities such as the U.S. Coast Guard, FAA Air Traffic, and Federal launch ranges.
    a. What current requirements related to agreements should be retained as is, modified, or eliminated?

b. Please identify any cost-effective performance based regulations regarding agreements.
c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations on agreements?
d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

13) *Launch Plans.* Part 417 requires a launch operator to have 11 plans, as follows:
- Flight safety plan.
- Ground safety plan.
- Launch support equipment and instrumentation plan.
- Configuration management and control plan.
- Frequency management plan.
- Flight termination system electronic piece parts program plan.
- Accident investigation plan.
- Local agreements and public coordination plans.
- Hazard area surveillance and clearance plan.
- Communications plan.
- Countdown plan.

a. Should the FAA require launch plans in general?
b. How should this rulemaking otherwise address the safety goals that these plans address?
c. Please identify any cost-effective performance based regulations regarding the safety goals that these launch plans address.
d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering the safety topics within these launch plans?
e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible, especially regarding changes to paperwork and recordkeeping requirements.

14) *Reviews.* Part 417 requires a hazardous operations safety readiness review, launch safety review, and a launch readiness review. Part 431 requires a mission readiness review.
a. How can this rulemaking preserve the level of safety accomplished by these reviews?
b. What current requirements related to reviews should be retained as is, modified, or eliminated?
c. Please identify any cost-effective performance based regulations regarding reviews.

d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering reviews?
e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

15) *Rehearsals.* Part 417 requires a countdown rehearsal, emergency response rehearsal, and a communications rehearsal. Part 431 requires dress rehearsal procedures.
    a. How should this rulemaking address these requirements?
    b. What current requirements related to rehearsals should be retained as is, modified, or eliminated?
    c. Please identify any cost-effective performance based regulations regarding rehearsals.
    d. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering rehearsals?
    e. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

16) *Mishaps.* Things can go wrong during launch operations, ranging from a minor anomaly to an accident in which public property is damaged or casualties occur.
    a. Should the FAA modify the current mishap definitions and the investigations that are required? If so, what modifications should be made?
    b. Please identify any cost-effective performance based regulations regarding mishaps.
    c. What standards are available or needed that would be suitable to demonstrate compliance with appropriate performance based regulations covering mishaps?
    d. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

17) *Policy and Payload Reviews.* In addition to launch and reentry safety, FAA licensing addresses national security and foreign policy interests of the United States (policy issues) and authorization of payloads not otherwise regulated or owned by the U.S. government.
    a. What current requirements related to policy and payload reviews should be retained as is, modified, or eliminated?
    b. Please identify expected benefits, savings and costs from your recommendations and suggestions. Provide quantitative data and estimates when possible.

## Appendix C – FAA Follow-up Questions

**FAA Follow-Up Questions**

1) Page 3, System Safety, Question (a). The ARC states that the system safety process should form the core of the FAA requirements.

   *Follow-up Question:* Does the ARC recommend that the system safety process be required for all launch and reentry scenarios and all flight phases, or would other safety approaches be acceptable in some circumstances? If so, please elaborate.

2) Page 4, System Safety, Question (e). The ARC states that the FAA should initiate a comprehensive review of an applicant's system safety processes at the start of the pre-application consultation phase to define the appropriate level of rigor for that applicant or vehicle program.

   *Follow-up Questions:*
   a) What data should the applicant provide the FAA for this purpose?
   b) How could the requirements be written to avoid the need for extensive negotiations between the FAA and applicant, like is currently required today under 14 CFR part 431?

3) Page 5, Flight Safety Systems, Question (b)(ii). The ARC states that the variables that go into a flight safety analysis should be used to determine what the required reliability of an FSS should be.

   *Follow-up Question:* How should an applicant demonstrate the reliability of a flight safety system that does not otherwise meet RCC-319 like standards?

4) Pages 5 and 6, Flight Safety Systems, Questions (a) and (b). The ARC states that a flight safety system should not be required; instead, an operator should be required to meet the allowed risk calculations in the Flight Safety Analysis, and that the current expected casualty requirements would be an appropriate performance for flight safety.

   *Follow-up Question*: A flight safety system is typically used to meet collective Ec and individual risk criteria and to prevent low probability, high consequence events to the public. Given the uncertainties associated with the inputs (e.g., probability of failure) of a flight safety analysis, how does the ARC propose an operator protect against low probability, high consequence events without a flight safety system?

5) Pages 6 - 7, Flight Safety System, Question (c). The ARC states that the FAA should scale required verification requirements by vehicle and operator category and relative risk. Categories could include new vehicle by new operator, proven vehicle by experienced operator, derived vehicle by experienced operator, vehicle hazard class, and sparsely or densely populated areas.

*Follow-up Question:* What would the ARC recommend as appropriate metrics and thresholds to establish and distinguish between classes of operator experience, vehicle hazard, and public exposure?

6) Page 7, Flight Safety Analysis, Question (a). The ARC states that because health monitoring and a decision to proceed precedes the overflight phase of flight, that phase of flight should get a separate risk budget from the prior phase of flight.

   *Follow-up Question:* Is this the correct interpretation? Currently, the FAA combines launch area and overflight risk into one risk budget.

7) Page 11, Flight Safety Analysis, Question (f). The ARC states that specifying a required level of fidelity and providing guidance for each level of fidelity should reduce iterations on analyses by at least 30%, resulting in reduced FTE costs devoted to licensing processes.

   *Follow-up Question:* Please clarify how a 30% reduction of analyses was derived.

8) Page 18, Application Process and Reporting Requirements, Question (a)(ii). The ARC states that the application review process should be modified to allow for incremental approvals of subsections to guide a focused review and avoid tolling.

   *Follow-up Question:* How would such an incremental approval process work? How would it fit within the FAA's statutory requirement to make a determination on a license application within 180 days?

9) Page 26, Hybrid Launch Vehicles, Question (b). The ARC recommends that AST and the Operator be allowed to define in the license when "launch" and "licensed activity" begins. The ARC further suggests that for Hybrid Systems the definition of "launch" could be the start of "pre-flight operations" or pre-launch sequence.

   *Follow-up Questions*:
   a) What pre-flight operations does the ARC believe should trigger the beginning of licensed activities? In other words, what pre-flight operations are inherently so hazardous as to warrant the FAA's regulatory oversight?
   b) Does the ARC believe that beginning of launch should be closely proximate in time to flight?

10) Page 30, Definition of Public Safety, Question (a). The ARC recommends that permanently badged personnel on a launch or reentry site not be considered "public."

    *Follow-up Question*: For the Air Force, neighboring operations personnel (NOP) are individuals, not associated with the specific operation or launch currently being conducted, but are required

to **perform safety, security, or critical tasks at the launch base**, and who are notified of a neighboring hazardous operation and are either trained in mitigation techniques or accompanied by a properly trained escort. The NOP may include individuals performing launch processing tasks for another launch, but **do not include individuals in training for any job or individuals performing routine activities such as administrative, maintenance, support, or janitorial**. NASA has a similar definition for NOP as the Air Force, but refers to them as Critical Operations Personnel. Some trainees, administrative, maintenance, support, and janitorial personnel on a site are likely to be permanently badged. Should these individuals be considered "public"? If not, why?

11) Page 31, Definition of Public Safety, Question (c). As a mitigation for uninvolved neighboring operations personnel when a hazardous operation or launch is scheduled, the ARC suggested that potential reciprocal waivers may be entered into among neighbors to share risks of hazards to each other's property and personnel.

    *Follow-up Question*: Does the ARC believe that FAA insurance requirements would then not need to apply to neighboring operations personnel?

12) Page 31, Definition of Public Safety, Question (c). The ARC states that the benefits of excluding permanently badged personnel from the definition of public would be to reduce regulatory burden and costs on both the operators and the FAA.

    *Follow-up Questions*:
    a) What costs do you incur when another operator conducts a launch?
    b) Do you have to vacate your employees from your facility?
    c) How many employees must vacate?
    d) Do these employees work remotely?
    e) Of these employees, what percentage of them are engineers, security personnel, administrative personnel, etc.?
    f) How much productive time per employee is lost?
    g) Are there other costs aside from those related to lost time or employee productivity?
    h) If so, what information can you give us about those costs (quantified and monetized, if possible)?

13) Page 35, Flight Hazard Areas. The ARC states that flight hazard areas should be risk based as opposed to containment based. The ARC further recommends that the FAA accelerate the capability for real-time air traffic management tools, particularly for periods following a mishap.

    *Follow-up Question:* Real-time air traffic management tools require the FAA to receive real-time state vector and other information from the launch or reentry operator. Is industry able to provide this information to the FAA in a cost-effective manner?

14) Page 39, Safety Organization and Personnel Qualifications, Question (a). The ARC recommends that the FAA remove the direct reporting structure of the Safety Official.

*Follow-up Question:* The direct reporting structure of the Safety Official is designed to ensure that safety concerns are addressed independently of mission assurance and that those concerns are conveyed to the person in charge of licensed launches. Does the ARC recommend an alternative means to provide safety independence?

# Appendix D – Building a Safety Case for FAA Licensing Purposes (Conceptual)

**Consequence Matrix**
**Inputs: vehicle description, flight profile modules**

| | Population Exposure | | |
|---|---|---|---|
| Vehicle Hazards | Risk Category B | Risk Category A | Risk Category A |
| | Risk Category C | Risk Category B | Risk Category A |
| | Risk Category C | Risk Category C | Risk Category B |

**Likelihood Matrix**
**Inputs: operator and vehicle historical information**

| | Vehicle Flight History | | |
|---|---|---|---|
| Operator Experience | Scrutiny Level II | Scrutiny Level I | Scrutiny Level I |
| | Scrutiny Level III | Scrutiny Level II | Scrutiny Level I |
| | Scrutiny Level III | Scrutiny Level III | Scrutiny Level III |

**Level of Rigor Matrix – Defines applicable regulatory modules/submodules (recall 9 boxes/nodules previously introduced) and scrutiny**

| | | Risk Category A | Risk Category B | Risk Category C |
|---|---|---|---|---|
| Three Interdependent Layers of a Complete Safety Case | FSA | Industry Recognized Tool<br><br>High Fidelity Inputs<br><br>FAA Vets Analysis Process | Part 420 Appendices<br><br>Flight Corridor Analysis | Part 437 Approach<br><br>Containment Analysis |
| | Operational Restrictions / FSS* | Reliability Analysis showing a minimum system reliability of 99.9%<br><br>AND<br><br>A rigorous test program consisting of:<br><br>Refined RCC 319 FSS Test Requirements (See Example Test Tables)<br><br>AND<br><br>Refined RCC 319 FSS System Analyses | Reliability Analysis showing a minimum system reliability of 99.9%<br><br>AND<br><br>Streamlined FSS Test Requirements (See Example Test Tables)<br><br>AND<br><br>Refined RCC 319 FSS System Analyses<br><br>OR | None Required |

| | | | | |
|---|---|---|---|---|
| | | OR<br><br>Other operational or design approach proven to address concerns of Low Probability/High Consequence Events | Defined flight rules that a human operator will use to restrict the flight...<br><br>We may need to say something about specific flight rules or restrictions and potentially some details about the mechanism of preventing flight into a populated area. | |
| | System Safety | System Safety Process<br><br>Configuration Management Process<br><br>Risk Management Process<br><br>Verification Process | System Safety Process<br><br>Verification Process | Hazard Analysis |
| Scrutiny Level | I | Complete verification data package (analysis, test, and inspection) documentation for safety critical items | | |
| | II | Verification by analysis | | |
| | III | Verification data not required | | |

## Example Test Requirements

A significant revision of either RCC 319-14 or Part 417 FTS requirements should be undertaken with a focus on making it performance based rather than prescriptive, but the test sections may form a solid basis for the testing of an FTU (if one is used in the system under review) under this revised approach. The following is provided as an example of how a new set of regulations can address the tiered risk approach.

**Autonomous Flight Termination Unit (AFTU) Qualification Testing Requirements**

| Test | Required? | Quantity Tested Risk Category A | Quantity Tested Risk Category B |
|---|---|---|---|
| Acceptance Tests | R | 3 | 1 |
| Performance Verification | | | |
| • Continuity and Isolation | R | 3 | 1 |
| • Input Current | R | 3 | 1 |
| • Terminate Decision Criteria | R | 3 | 1 |
| • Abbreviated Terminate Criteria | R | 3 | 1 |
| • Output Firing Circuit | R | 3 | 1 |
| • Command and Control | R | 3 | 1 |
| • Output Monitors | R | 3 | 1 |
| • Circuit Protection | | | |
| ◦ Low Voltage | R | 3 | 1 |
| ◦ Dropout | R | 3 | 1 |

| | | | |
|---|---|---|---|
| • <br>  ○ Watchdog Circuit | ER | 3 | 1 |
| • Self Test | R | 3 | 1 |
| Abbreviated Performance Verification | | | |
| • Output Monitors | R | 3 | 1 |
| • Input Current | R | 3 | 1 |
| • Abbreviated Terminate Criteria | R | 3 | 1 |
| Environment Tests – Non-Operating | | | |
| • Storage Temperature | R | 3 | 1 |
| • Transportation Vibration | R | 3 | 1 |
| • Transportation Shock | R | 3 | 1 |
| • Bench Handling Shock | R | 3 | 1 |
| • Fungus Resistance | ER | 1 | 1 |
| • Fine Sand | ER | 1 | 1 |
| Environment Tests – Operating | | | |
| • Thermal Cycle | R | 3 | 1 |
| • Thermal Vacuum | ER | 3 | 1 |
| • Humidity | ER | 3 | 1 |
| • Salt Fog | ER | 2 | 1 |

| | | | |
|---|---|---|---|
| • Temperature/Humidity/Altitude | ER | 3 | 1 |
| • Acceleration | ER | 3 | 1 |
| • Sinusoidal Vibration | ER | 3 | 1 |
| • Random Vibration | R | 3 | 1 |
| • Acoustic Vibration | ER | 3 | 1 |
| • Shock | R | 3 | 1 |
| • EMI/EMC | R | 1 | 1 |
| • Explosive Atmosphere | ER | 2 | 1 |
| • Memory | ER | 3 | 1 |
| • Repetitive Functioning | R | 3 | 1 |
| • Circuit Protection | R | 1 | 1 |
| • Leakage | ER | 3 | 1 |
| • Internal Inspection | R | 3 | 1 |

**Autonomous Flight Termination Unit (AFTU) Acceptance Testing Requirements**

| Test | Required? | Quantity Tested Risk Category A | Quantity Tested Risk Category B |
|---|---|---|---|
| Component Examination | R | 100% | 100% |
| Performance Verification | | | |
| • Continuity and Isolation | R | 100% | 100% |
| • Input Current | R | 100% | 100% |
| • Terminate Decision Criteria | R | 100% | 100% |
| • Abbreviated Terminate Criteria | R | 100% | 100% |
| • Output Firing Circuit | R | 100% | 100% |
| • Command and Control | R | 100% | 100% |
| • Output Monitors | R | 100% | 100% |
| • Circuit Protection | | | |
| ◦ Low Voltage | R | 100% | 100% |
| ◦ Dropout | R | 100% | 100% |
| ◦ Watchdog Circuit | ER | 100% | 100% |
| • Self Test | R | 100% | 100% |
| Abbreviated Performance Verification | | | |

| | | | |
|---|---|---|---|
| • Output Monitors | R | 100% | 100% |
| • Input Current | R | 100% | 100% |
| • Abbreviated Terminate Criteria | R | 100% | 100% |
| Environment Tests – Operating | | | |
| • Thermal Cycle | R | 100% | 100% |
| • Thermal Vacuum | ER | 100% | 100% |
| • Sinusoidal Vibration | ER | 100% | 100% |
| • Random Vibration | R | 100% | 100% |
| • Acoustic Vibration | ER | 100% | 100% |
| • Leakage | ER | 100% | 100% |

Notes on the above test tables:

- Based (heavily) on the Qualification test table from RCC 319-14 as Part 417 does not contain requirements for an Autonomous Flight Termination Unit
- Required (R) or Evaluation Required (ER) approach and designations borrowed from SMC-S-016
    - Required (R) items will likely be required for all potential FSS
    - Evaluation Required (ER) items may be satisfied by an analysis that shows the environment does not apply
        - Example: A unit that has a sinusoidal vibration environment that is fully encompassed by the random vibration testing does not need a sinusoidal vibe test
    - Intent is to provide clearer guidance of what tests should typically be considered hard requirements and which tests need to be evaluated for applicability
    - Provides a path to provide analysis in lieu of not-applicable tests (hopefully improving flexibility of new rules)
- There is the option to remove some tests from the Category B test set completely

## Appendix E – Findings and Work of the Task Group

The additional content contained in this file has been compiled by the Draft Regulatory Text Task Force within the SLR2 ARC and has the specific support of the following Streamlining ARC members: Blue Origin, Sierra Nevada, SpaceX, and Space Florida.

Enclosed please find the following:

1. A draft rule set.
    - The group mapped existing Part 431/415/417/420 regulations to the new proposed modules presented by the ARC (and repeated on the following page). For ease of reference, we called the new rule set "Part 489 Launch & Reentry Licensing." See the new proposed table of contents for Part 489 to see what existing regulations mapped to what modules.

    - If we did not include an existing Part 415/417/431 regulation call out in the attached table of contents, we intend for that regulation to be deleted from the new rule set. We highlight that some of that rule content may be acceptable and important to include in guidance documents.

    - When a Part 415/417/431 regulation is called in the attached table of contents we intend for the idea of that regulation to be captured in the new rule set (but not necessarily the exact language).

    - In some cases we have proposed redlined language to the existing rules. If you do not find redlined language, we just did not have time to address it. It does not mean we are in full agreement with the current form of the rule. Our intent is merely to provide some idea of what we are thinking with respect to translating the ARC's answers to FAA's questions into regulatory language.

2. In addition to filling in the new Part 489 licensing modules, we also included:
    - A "General" section in Part 489 with purpose and scope regulations;
    - An environmental section that runs parallel to the core set of licensing modules and represents the NEPA/Environmental review that must be satisfied as part of the licensing process.
    - A proposed Part 499 "Post Licensing and Inspection" regulations. We thought it clearer and important to separate this from the requirements involved in obtaining a license.
    - Proposed redlines to Part 413 regulations that we feel are necessary to implement a modular approach, reduce review timelines, and increase overall efficiency of the licensing process. We did not do an exhaustive review of every current Part 413 rule. We focused on what we thought most important to clarify the responses provided by the ARC industry team. For example, we expect that AST would scrub Part 413 to remove clearly outdated references to deliveries of hardcopies in duplicate – we chose to spend our limited time on more substantive issues.
    - A list of proposed Guidance document content to support the proposed rule sets.

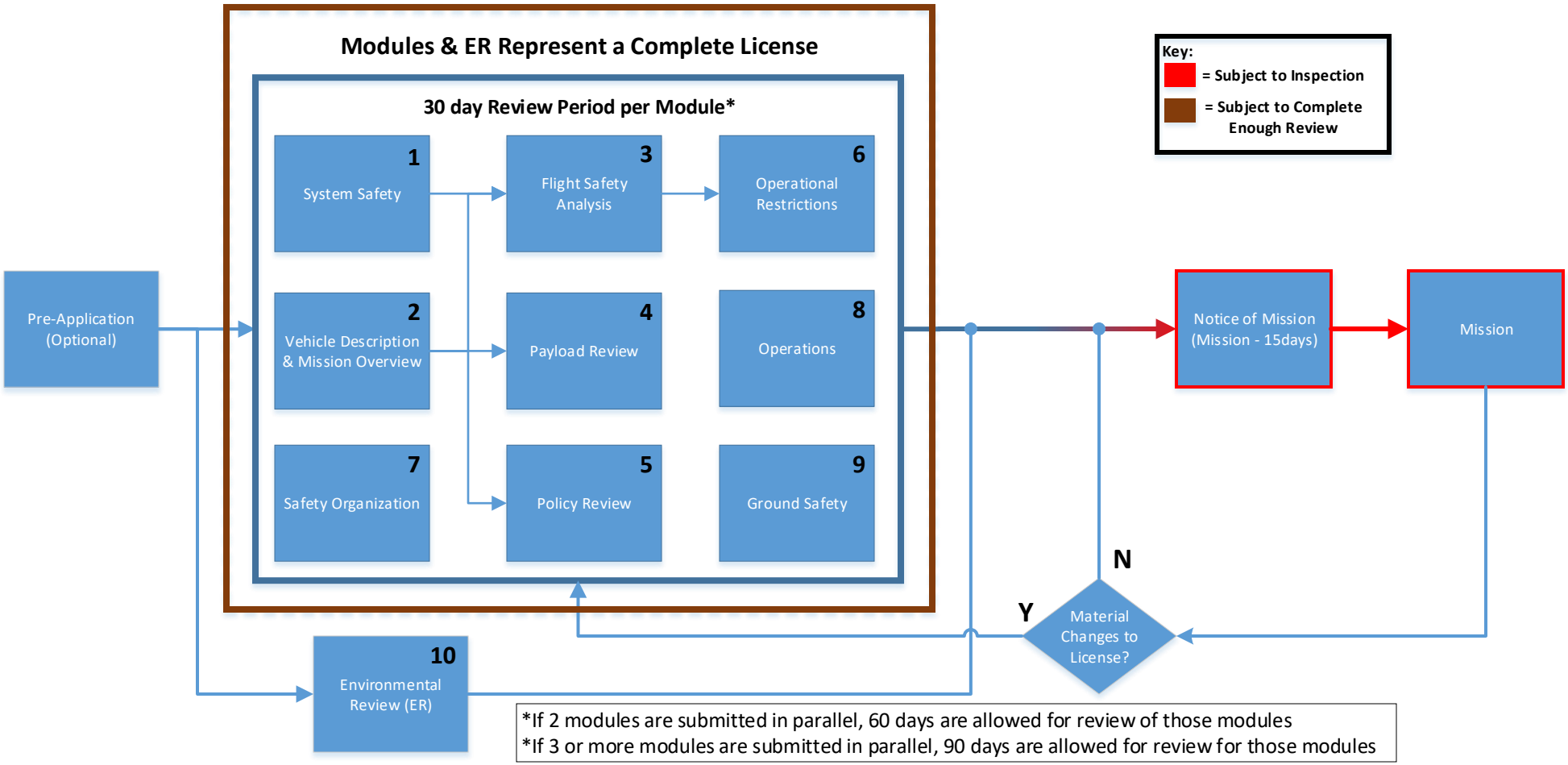
We appreciate the consideration and repeat our interest in continuing to work these matters with you in the coming months.

Below is a list of guiding principles that were developed in order to insure a proposed regulatory framework and draft regulatory inputs that meet the current level of safety while offering more flexibility in the licensing process. Focusing on the following components will result in initial and recurring safety and economic benefits through increased flexibility, reduced paperwork burden, and an expansion of commercial activities.

1) Performance Based
   a) Measure of performance Ec
   b) Means of complying can vary and left up to operator
2) Flexibility
   a) Single license structure to accommodate a variety of vehicle types and operations and launch/reentry sites
   b) Allow for coordinated determination of applicable regulations prior to application submission
   c) Ability to meet regulations without waivers
   d) Use Guidance Documents to facilitate frequent updates
3) Reform Pre Application Process and Requirements
   a) "Complete Enough" is the real criteria for entering application evaluation;
   b) Completion of a pre-app process is not a requirement for application acceptance or complete enough determination
   c) Experience vs inexperienced; known vs unknown vehicles
4) Defined review timelines
   a) Restructured rules support shorter, more efficient review
   b) Increased predictability for industry
   c) For new and continuing accuracy submissions
   d) Existing timelines significantly reduced
5) Continuing Accuracy requirements
   a) Based on public safety impact based on Ec
6) FAA Jurisdiction
   a) Limited to activities so publicly hazardous as to warrant FAA's oversight
   b) Well defined inspection criteria
7) Eliminate Duplicative Jurisdiction on Federal Ranges
   a) References in rules to Range jurisdiction
   b) NSpC recommendation to revise licensing regime in coordination with members of NSpC

To meet the National Space Council's objective of having a performance based and streamlined regulatory framework for commercial launch and reentry licenses, a modular approach was developed. This approach maintains the core elements of licenses today while capitalizing on a modular approach that enables faster evaluations times and the ability to receive partial evaluation early in vehicle development as a method of risk reduction for an applicant. The figure below depicts a flow diagram of the proposed regulatory framework from the initial engagement with AST through flying multiple missions under an issued license.

# Licensing Flow



The process begins with an optional pre-application phase. Industry believes this should be optional to an applicant as they may be experienced in license applications or hire-in expertise that does not require the dialog that pre-application offers. Overall, pre-application is viewed as an optional risk mitigation that an applicant can use to prevent any unforeseen items in the complete enough review. AST retains the "complete enough" determination to prevent inadequate applications from proceeding to the consideration process, and AST should use this gate to provide substantive feedback to applicants whose application packages are insufficient.

The core of the license application is broken into 9 modules that cover the components of a complete license application. The intent here is that the 9 modules are as independent in terms of content as possible to allow applicants to submit modules for evaluation as they see fit for their program. Some modules will necessarily depend on others, thus there is an order of operations indicated by arrows between some of the modules. Each module when submitted will go through a complete enough review that has a 7 day deadline for AST determination. Once accepted as complete enough, each module has a 30 day review period. The applicant has the option to submit the modules in series or parallel; whichever best fits the applicant's development plans and risk posture. Due to some of the dependencies between modules, the AST review periods are scaled per the following:

- If 2 modules are submitted in parallel, 60 days are allowed for review of those modules
- If 3 or more modules are submitted in parallel, 90 days are allowed for review for those modules

It should be noted that due to the NEPA process for submitted and evaluating an environmental assessment, a separate module outside of the core 9 modules is represented on the flow chart. It is recommended that AST work with the other federal partners to better define and limit the review period on the EA process to make the total licensing effort more efficient.

Once all of the modules have been deemed complete enough and reviews are completed with a positive determination is issued, a license is granted to the applicant. The license will be valid for 5 years, under which an infinite number of operations can occur that meet the conditions of the granted license application. The items in red on the flow chart indicate where inspections would occur in order to demonstrate compliance with the issued license and continuing accuracy. Only "material changes" (a new defined term) require the licensee to submit amended application materials to FAA and warrant an update to the license. These changes would be accessible by inspectors during those periods of time leading up to and through a licensed activity.

Leading up to a license activity a Notice of Mission is issued at mission minus 15 days. This is where items identified in the Notice of Mission Plan, as defined in the license, would be completed/delivered to AST. Once the mission is completed, an operator can conduct other missions following the same process as long as the conditions of the License still apply. In the case an operator wants to add capability or make a modification in the License, only the affected modules need to be submitted for reevaluation. Once those have been approved by AST, missions utilizing the updated conditions can be executed. It is important to note that at any time a module is being updated or reevaluated, operations can still occur under the bounds of the existing, issued license.

**CODE OF FEDERAL REGULATIONS**

**Title 14 → Chapter III → Subchapter C → Part 489**

**Title 14: Aeronautics and Space**

**PART 489—Launch and Reentry Licensing**

AUTHORITY: 51 U.S.C. 5090150923.
SOURCE: Docket No. FAAxxxxxx

**Subpart A - General**
§431.1 Scope.
§431.5 Policy and safety approvals.
§431.8 Human space flight.
§431.9 Issuance of a license.
§431.11 Additional license terms and conditions.
§431.13 Transfer of a license.
§431.15 Rights not conferred by a license.
§431.27 Denial of policy approval.

**Subpart B – Module 1: System Safety**
§431.35(c); (d)(7) "Acceptable Mission Risk"
§431.43(a)(1),(2) "System Safety Operational Requirements"

**Subpart C – Module 2: Vehicle Description & Mission Overview**
§431.25(a);(b);(d) Application requirements for policy review.
§431.35(d)(1),(2),(5) Acceptable mission risk.

**Subpart D – Module 3: Flight Safety**
§431.35(a); (b); (d)(3),(4),(6),(8) "Acceptable Mission Risk"
§431.43(b);(c)(3) "Operational Requirements"

**Subpart E – Module 4: Payload Review**
§431.51(a) General.
§431.53(a)? Classes of Payloads
§431.55/Part 415 Subpart D Payload review.
§431.57/ Part 415 Subpart D Information requirements for payload review.

**Subpart F – Module 5: Policy Review**
§431.23 Policy review.

**Subpart G – Module 6: Operational Restrictions**
§431.39 (mission rules only) "Mission Rules"
§431.43(e) "Operational Restrictions"

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**Subpart H – Module 7: Safety Organization**
§431.33 Safety Organization.

**Subpart I – Module 8: Operations**
§431.37 Mission readiness.
§431.39 (all but mission rules) “Procedures, Contingency Plans, and Checklists”
§431.41 Communications plan.
§431.43(a)(3),(4); (c)plan for COLA; (c)(4) “Operational Requirements”
§431.45 “Mishap Investigation and Emergency Response Plan” (Add §431.77(b) and §431.79(c))
§431.75 Agreements.

**Subpart J – Module 9: Ground Safety**
§417.411 Safety clear zones for hazardous operations.

**Subpart K – Module 10: Environmental**
§431.91 General.
§431.93 Environmental information.

4

## Subpart A - General

**§431.1 Scope.**
New proposed content:

- Subparts B – K each represent their own unique module.
- Each module can be submitted individually or grouped as the applicant deems necessary.
- Applicable review timelines defined in Part 413.
- Modules are customizable to the applicant, vehicle and operations. Applicable modules to be determined collaboratively by the Applicant and FAA.
- FAA will consider and issue an approval for each module as it is submitted and will issue a license upon a positive determination on all applicable modules.
    - The FAA advises an applicant, in writing, of any issue raised during a module review that would impede issuance of an approval. The applicant may respond, in writing, or revise its license application.
- Applicants must receive approval for all applicable modules to obtain a license under this part.

**§431.3 Types of licenses**

A license authorizes a licensee to launch and reenter, or otherwise land, any of a designated family of vehicles within authorized parameters, including launch sites and trajectories, transporting specified classes of payloads to any reentry site or other location designated in the license. A license is valid for a five-year renewable term. A licensee's authorization to conduct licensed activities terminates upon the expiration date stated in the license or up on notification by FAA that activities must be suspended.

**Deleted: reusable launch vehicle mission**

**Deleted:** (a) *Mission-specific license.* A mission-specific license authorizing an RLV mission authorizes a licensee to launch and reenter, or otherwise land, one model or type of RLV from a launch site approved for the mission to a reentry site or other location approved for the mission. A mission-specific license authorizing an RLV mission may authorize more than one RLV mission and identifies each flight of an RLV authorized under the license. A licensee's authorization to conduct RLV missions terminates upon completion of all activities authorized by the license or the expiration date stated in the reentry license, whichever occurs first.

**Deleted:** (b) *Operator license.* An operator license for RLV missions authorizes a licensee to launch and reenter, or otherwise land, any of a designated family of RLVs within authorized parameters, including launch sites and trajectories, transporting specified classes of payloads to any reentry site or other location designated in the license. An operator license for RLV missions is valid for a two-year renewable term.

**§431.8 Human space flight.**

To obtain a license, an applicant proposing to conduct a ~~reusable launch vehicle~~ mission with flight crew or a space flight participant on board must demonstrate compliance with §§460.5, 460.7, 460.11, 460.13, 460.15, 460.17, 460.51 and 460.53 of this subchapter.

**§431.9 Issuance of a ~~reusable launch vehicle mission~~ launch or reentry license.**

~~An RLV mission~~ A license authorizes a licensee to launch and reenter, or otherwise land, ~~an RLV~~ a launch or reentry vehicle and payload, if any, in accordance with the representations contained in the licensee's application, subject to the licensee's compliance with terms and conditions contained in license orders accompanying the license, including financial responsibility requirements.

**§431.11 Additional license terms and conditions.**

The FAA may amend ~~an RLV mission~~ a license at any time by modifying or adding license terms and conditions to ensure compliance with 51 U.S.C. Subtitle V, chapter 509, and applicable regulations.

**§431.13 Transfer of a mission license.**

(a) Only the FAA may transfer ~~an RLV mission~~ a license.

(b) An applicant for transfer of ~~an RLV mission~~ a license shall submit a license application in accordance with part 413 of this subchapter and satisfy the applicable requirements of this part. The FAA will transfer ~~an RLV mission~~ a license to an applicant who has obtained all of the approvals and determinations required under this chapter for ~~an RLV mission~~ a license. In conducting its reviews and issuing approvals and determinations, the FAA may incorporate any findings made part of the record to support the initial licensing determination. The FAA may modify ~~an RLV mission~~ a license to reflect any changes necessary as a result of a license transfer.

**§431.15 Rights not conferred by a license.**

Issuance of ~~an RLV mission~~ a license does not relieve a licensee of its obligation to comply with requirements of law that may apply to its activities.

**§431.27 Denial of policy approval.**

The FAA notifies an applicant, in writing, if the FAA has denied ~~policy~~ approval for ~~an RLV mission~~ a subpart/module or full license application. The notice states the reasons for the FAA's determination. The applicant may respond to the reasons for the determination

**Deleted:** (a) The FAA issues ~~either a mission-specific or operator license authorizing RLV missions~~ a license to an applicant who has obtained all approvals and determinations required under this chapter for the license.¶

**Deleted:** (b)

**Deleted: reusable launch vehicle**

**Deleted: reusable launch vehicle mission**

## Subpart B – Module 1: System Safety

**§431.35(c); (d)(3),(4),(7) "Acceptable Mission Risk"**

(c) To demonstrate compliance with acceptable risk criteria in this section, an applicant shall employ a system safety process to identify the hazards and assess the risks to public health and safety and the safety of property associated with the mission, including nominal and non-nominal operation and flight of the vehicle and payload, if any. An acceptable system safety analysis identifies and assesses the probability and consequences of any reasonably foreseeable hazardous event, and safety-critical system failures during launch flight or reentry that could result in a casualty to the public.

**Commented [AP1]:** Guidance document recommendations:
-Contents of 417.107
-Contents of "Building System Safety Case" submitted by industry during Streamlining ARC

(d) As part of the demonstration required under paragraph (c) of this section, an applicant must—

(3) Identify and describe safety-critical systems;

(4) Identify and describe all safety-critical failure modes and their consequences;

(7) Provide data that verifies the risk elimination and mitigation measures resulting from the applicant's system safety analyses required by paragraph (c) of this section;

**§431.43(a)(1),(2) "System Safety Operational Requirements"**

(a) An applicant for ~~a~~ license shall submit procedures—

**Deleted:** ~~RLV mission~~

**Deleted:** safety approval

(1) That ensure ~~RLV~~ mission risks do not exceed the criteria set forth in §431.35 for nominal and non-nominal operations;

(2) That ensure conformance with the system safety process and associated hazard identification and risk assessment required under §431.35(c);

## Subpart C – Module 2: Vehicle Description and Mission Overview

**§431.25(a);(b);(d) Application requirements for policy review.**

(a) Identify the model, type, and configuration of any ~~RLV~~ vehicle proposed for launch and reentry, where applicable, ~~or otherwise landing on Earth~~, by the applicant.

(b) Identify all vehicle systems, including structural, thermal, pneumatic, propulsion, electrical, and avionics and guidance systems used in the vehicle(s), and all propellants.

(d) Identify proposed launch and reentry flight profile(s), including—

(1) Launch and reentry site(s), including planned contingency abort locations, if any;

(2) Flight trajectories, reentry trajectories, associated ground tracks, and instantaneous impact points for nominal operations, and contingency abort profiles, if any;

(3) Sequence of planned events or maneuvers during the mission; and for an orbital mission, the range of intermediate and final orbits of the vehicle and upper stages, if any, and their estimated orbital life times.

**§431.35(d)(1),(2),(5) Acceptable mission risk.**

Deleted: reusable launch vehicle

(d) As part of the demonstration required under paragraph (c) of this section, an applicant must—

(1) Identify and describe the structure of the ~~RLV~~ vehicle, including physical dimensions and weight;

(2) Identify and describe any hazardous materials, including radioactive materials, and their container on the RLV;

(5) Provide drawings and schematics for each safety-critical system identified under paragraph (d)(3) of this section;

## Subpart D – Module 3: Flight Safety Analysis

**§431.35(a); (b); (d)(6),(8) "Acceptable Mission Risk"**

(a) To obtain ~~an RLV~~ approval for this module, an applicant must demonstrate that the proposed mission does not exceed acceptable risk as defined in this subpart. For purposes of this subpart, the mission commences upon initiation of the launch phase of flight and consists of launch flight through orbital insertion of an RLV or vehicle stage or flight to outer space, whichever is applicable, and reentry or descent flight, and concludes upon landing on Earth of the RLV.

(b) Acceptable risk for a proposed mission is measured in terms of the expected average number of casualties (Ec).

(1) To obtain safety approval, an applicant shall demonstrate:

(i) For public risk, the risk level to the collective members of the public exposed to vehicle or vehicle debris impact hazards associated with a proposed mission does not exceed an expected average number of 0.00003 casualties per mission (or Ec criterion of 30 × 10−6) to members of the public from the applicant's proposed activity; and

(ii) For public risk, the risk level to an individual does not exceed .000001 per mission (or individual risk criterion of 1 × 10−6).

(d) An applicant must—

(6) Provide a timeline identifying all safety-critical events;

(8) Provide flight trajectory analyses covering launch or ascent of the vehicle through orbital insertion and reentry or descent of the vehicle through landing, including its three-sigma dispersion.

(e) [Note: If FAA believes additional justification beyond the Ec analysis is required to account for low probability, high consequence events, regulations could be included here that require such justification. Then, for example, applicants who use a flight safety system for this purpose could benefit from an associated guidance document that includes portions of RCC 319.]

**§431.43(b);(c)(3) "Operational Requirements"**

(b) To satisfy risk criteria set forth in §431.35(b)(1), an applicant for ~~an RLV mission~~ a license shall identify suitable and attainable locations for nominal landing and vehicle staging impact or landing, if any. An application shall identify such locations for a contingency abort if necessary to satisfy risk criteria contained in §431.35(b)(1) during launch. ~~of an RLV~~. A nominal landing, vehicle staging impact and contingency abort location are suitable for launch or reentry if—

(1) For any vehicle or vehicle stage, the area of the predicted three-sigma dispersion of the vehicle or vehicle stage can be wholly contained within the designated location; and

Deleted: (3),(4),

Deleted: safety approval for

Deleted: a mission

Deleted: section

Commented [AP2]: This is verbose and confusing. We agree that Ec should apply to the flight phase (as opposed to pre or post flight ground operations), however there is likely a better way to capture that scope.

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Deleted: safety approval

(2) The location is of sufficient size to contain landing impacts, including debris dispersion upon impact and any toxic release.

(c) For ~~an RLV~~ all licensed missions—

(3) There will be no unplanned physical contact between the vehicle or its components and payload after payload separation and debris generation will not result from conversion of energy sources into energy that fragments the vehicle or its payload. Energy sources include, but are not limited to, chemical, pneumatic, and kinetic energy;

## Subpart E – Module 4: Payload Review

**§431.51 (a), (b) General.**

(a) A payload ~~reentry~~ review is conducted to examine the policy and safety issues related to the proposed reentry of a payload, other than a U.S. Government payload or a payload whose launch and reentry, where applicable, is subject to regulation by another Federal agency, to determine whether the FAA will approve ~~reentry of~~ the payload.

(b) A payload review may be conducted as part of a license application review or may be requested by a payload owner or operator in advance of or separate from a license application.

**Deleted:** reentry

**Deleted:** an RLV mission

**Deleted:** an RLV mission

**§431.53(a) Classes of Payloads**

(a) The FAA may approve the launch or return of a type or class of payload. ~~(for example, communications or microgravity/scientific satellites).~~

**Commented [AC3]:** Put in guidance, or define examples in definitions

**§431.55/415 (Subpart D) Payload ~~reentry~~ review.**

(a) In conducting a payload ~~reentry~~ review to decide if the FAA should approve launch or reentry of a payload, the FAA determines whether its launch or reentry presents any issues that would adversely affect U.S. national security or foreign policy interests, would jeopardize public health and safety or the safety of property, or would not be consistent with international obligations of the United States.

(b) The FAA consults with the Department of Defense to determine whether launch or reentry of a proposed payload presents any issues adversely affecting U.S. national security.

(c) The FAA consults with the Department of State to determine whether launch or reentry of a proposed payload presents any issues adversely affecting U.S. foreign policy interests or international obligations.

(d) The FAA consults with other Federal agencies, including the National Aeronautics and Space Administration, authorized to address issues identified under paragraph (a) of this section.

**§431.57/415 (Subpart D) Information requirements for payload ~~reentry~~ review.**

A person requesting ~~reentry~~ review of a particular payload or payload class must identify the following:

(a) Payload name or class and function;

(b) Physical characteristics, dimensions, and weight of the payload;

(c) Payload owner and operator, if different from the person requesting the payload ~~reentry~~ review;

(d) Type, amount, and container of hazardous materials, as defined in §401.5 of this chapter, and radioactive materials in the payload;

(e) Explosive potential of payload materials, alone and in combination with other materials found on the payload or ~~RLV~~ during launch or reentry;

(f) Designated reentry site(s), where applicable; and

(g) Method for securing the payload on the ~~RLV~~ vehicle.

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## Subpart F – Module 5: Policy Review

**§431.23 Policy review.**

(a) The FAA reviews ~~an RLV mission~~ a license application to determine whether the proposed mission presents any issues, other than those issues addressed in the safety review, that would adversely affect U.S. national security or foreign policy interests, would jeopardize public health and safety or the safety of property, or would not be consistent with international obligations of the United States.

(b) Interagency consultation is conducted as follows:

(1) The FAA consults with the Department of Defense to determine whether ~~an RLV mission~~ a license application presents any issues adversely affecting U.S. national security.

(2) The FAA consults with the Department of State to determine whether ~~an RLV mission~~ a license application presents any issues adversely affecting U.S. foreign policy interests or international obligations.

(3) The FAA consults with other Federal agencies, including the National Aeronautics and Space Administration, authorized to address issues identified under paragraph (a) of this section, associated with an applicant's ~~RLV~~ mission proposal.

(c) The FAA advises an applicant, in writing, of any issue raised during a policy review that would impede issuance of a policy approval. The applicant may respond, in writing, or revise its license application.

## Subpart G – Module 6: Operational Restrictions

**§431.39 Mission rules.**

(a) An applicant shall submit mission rules~~, procedures, checklists, emergency plans, and contingency abort plans, if any,~~ that ensure safe conduct of mission operations during nominal and non-nominal vehicle flight.

(b) Mission rules~~, procedures, checklists, emergency plans, and contingency abort plans~~ must be contained in a safety directive, notebook, or other compilation that is approved by the safety official designated under §431.33(c) and concurred in by the launch site operator and reentry site operator, if any.

**§431.43(e) Operational Restrictions.**

(e) Any ~~RLV~~ vehicle that enters Earth orbit may only be operated such that the vehicle operator is able to—

(1) Monitor and verify the status of safety-critical systems before enabling reentry flight to assure the vehicle can reenter safely to Earth; and

(

## Subpart H – Module 7: Safety Organization

**§431.33 Safety Organization.**

(a) An applicant shall maintain a safety organization and document it by identifying lines of communication and approval authority for all mission decisions that may affect public safety. Lines of communication within the applicant's organization, between the applicant and the launch site, and between the applicant and the reentry site, where applicable, shall be employed to ensure that personnel perform ~~RLV~~ licensed operations in accordance with plans and procedures required by this subpart. Approval authority shall be employed to ensure compliance with terms and conditions stated in ~~an RLV mission~~ a license and with the plans and procedures required by this subpart.

(b) An applicant shall have qualified "Mission Directors" (or equivalent) who can be assigned to each licensed activity as the person ultimately responsible for the conduct of the licensed ~~RLV mission~~ activity.

(c) An applicant shall designate qualified safety officials authorized by the applicant to examine all aspects of the applicant's operations with respect to safety of ~~RLV~~ licensed activities and to monitor independently compliance by vehicle safety operations personnel with the applicant's safety policies and procedures. The safety official shall have a reporting responsibility to the Mission Director who shall ensure that all of the safety official's concerns are addressed both before a mission is initiated and before reentry or descent flight ~~of an RLV~~ is initiated, where applicable.
The safety official is responsible for—

**Deleted:** , procedures, contingency plans, and checklists

**Commented [AC4]:** These are included in the Operations section/module.

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**Deleted:** 2) Issue a command enabling reentry flight of the vehicle. Reentry flight cannot be initiated autonomously under nominal circumstances without prior enable.

**Deleted:** mission

**Commented [AP6]:** 1.Can we just use "Mission Director or equivalent"? Using this phrase everywhere is cumbersome and confusing.
2. A licensee will have more than one person capable of being the Launch Director/Flight Director/Mission Director and more than one person capable of being the "Safety Official." The requirement here should just be that the applicant have the position in their safety organization; then include a requirement in the L-15d Notice of Mission report to identify who that person is for each flight activity.

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(1) Monitoring and evaluating operational dress rehearsals to ensure they are conducted in accordance with procedures required by §431.37(a)(4) and under §431.37(a)(1)(iv) to ensure the readiness of vehicle safety operations personnel to conduct a safe mission under nominal and non-nominal conditions; and

(2) Completing a mission readiness determination as required by §431.37 before ~~an RLV~~ mission is initiated. The safety official must monitor and report to the person responsible for the conduct of licensed ~~RLV~~ activities any noncompliance with procedures listed in §§431.37 and 431.43, or any representation contained in the application, and the readiness of the licensee to conduct mission operations in accordance with the license and this part.

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**Deleted:** safety official is responsible for compliance with §§431.37 and 431.43, and with representations contained in the application.

## Subpart I – Module 8: Operations

489.X Notice of Mission Plan

**Commented [AP8]:** Include 415 Appendix A (Space Command Template) in a guidance document

[Add new regulation to identify everything a licensee must submit at L-15d, *e.g.*, mission specific COLA, DLs, and rules; final payload manifest.]

**§431.37 Mission readiness.**

(a) *Mission readiness requirements.* An applicant shall submit the following procedures for verifying mission readiness:

(1) Mission readiness review procedures that involve the applicant's vehicle safety operations personnel and launch site and reentry site personnel involved in the mission. The procedures shall ensure a mission readiness review is conducted during which the designated individual responsible for the conduct of licensed activities under §431.33(b) is provided with the following information to make a judgment as to mission readiness—

**Commented [AC9]:** Recommend 417.117(g) guidance

**Deleted:** ,

(i) Readiness of the ~~RLV~~ vehicle, including safety-critical systems and payload for launch and reentry flights, where applicable;

(ii) Readiness of the launch site, personnel, and safety-related launch property and launch services to be provided by the launch site;

(iii) Readiness of the reentry site, personnel, and safety-related property and services for reentry flight and vehicle recovery;

(iv) Readiness of vehicle safety operations personnel to support mission flight, including results of dress rehearsals and simulations conducted in accordance with paragraph (a)(4) of this section;
(v) Mission rules and constraints, including contingency abort plans and procedures, if any, as required under §431.39;

(vi) Unresolved safety issues identified during the mission readiness review and plans for addressing them; and

(vii) Any additional safety information required by the individual designated under §431.33(b) to determine launch and reentry readiness.

(2) Procedures that ensure mission constraints, rules, contingency abort and emergency abort procedures are listed and consolidated in a safety directive or notebook approved by the person designated by the applicant under §431.33(b), the launch site operator, and the reentry site operator, if any;

(3) Procedures that ensure currency and consistency of licensee, launch site operator, and reentry site operator checklists, where applicable;

(4) Rehearsal procedures that—

(i) Ensure vehicle safety operations personnel readiness under nominal and non-nominal flight conditions;

(ii) Contain criteria for determining whether to dispense with or add one or more rehearsals; and

(iii) Verify currency and consistency of licensee, launch site operator, and reentry site operator checklists; and

(5) Procedures for ensuring the licensee's vehicle safety operations personnel adhere to crew rest rules of this part.

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**§431.39 "Procedures, Contingency Plans, and Checklists"**

(a) An applicant shall submit ~~mission rules,~~ procedures, checklists, emergency plans, and contingency abort plans, if any, that ensure safe conduct of mission operations during nominal and non-nominal vehicle flight. At the time of application, the applicant will submit documents representative of the final documents that will be executed during the mission. Inspection Division personnel shall have access to all procedures during the conduct of mission operations.

**Commented [AC10]:** Mission rules included in Operational Restrictions section/module

(b) ~~Mission rules,~~ Procedures, checklists, emergency plans, and contingency abort plans must be contained in a safety directive, notebook, or other compilation that is approved by the safety official designated under §431.33(c) and concurred in by the launch site operator and reentry site operator, if any.

(c) Vehicle safety operations personnel must have access to current and consistent mission checklists.

**§431.41 Communications plan.**

(a) An applicant shall submit a plan providing vehicle safety operations personnel communications procedures during the mission. Procedures for effective issuance and communication of safety-critical information during the mission shall include hold/resume, go/no go, contingency abort, if any, and emergency abort commands by vehicle safety operations personnel. The communications plan shall describe the authority of vehicle safety operations personnel, by individual or position title, to issue these commands. The communications plan shall ensure that—

(1) Communication networks are assigned so that personnel identified under this section have direct access to real-time, safety-critical information required for making decisions and issuing commands;

(2) Personnel identified under this section monitor a common intercom channel for safety-critical communications during launch and reentry;

(3) A protocol is established for utilizing defined radio communications terminology; and

(4) Communications affecting the safety of the mission are recorded in a manner that accurately reflects communications made on individual channels, synchronized time coding, and sequence of communications.

(b) An applicant shall submit procedures to ensure that licensee site personnel, if any, receive a copy of the communications plan required by this section and that the site operator, if any, concurs with the communications plan.

**§431.43(a)(3),(4); (c)plan for COLA; (c)(4); 417.113(f) "Operational Requirements"**

(a) An applicant for ~~RLV mission~~ a license shall submit procedures—

(1) To monitor and verify the status of ~~RLV~~ vehicle safety-critical systems sufficiently before enabling both launch and reentry flight to ensure public safety and during mission flight unless technically infeasible;

(2) that provide applicant's plan for obtaining COLA restrictions.

(4) *Crew work shift and rest rules.* For any operation with the potential to have an adverse effect on public safety, the safety rules must ensure the vehicle safety operations personnel is physically and mentally capable of performing all assigned tasks. These rules must govern the length, number, and frequency of work shifts, including the rest afforded the launch crew between shifts.

**§431.45, §431.77(b) and §431.79(c) "Mishap Investigation and Emergency Response Plan"**

(a) *Mishap investigation plan and emergency response plan.* An applicant shall submit a mishap investigation plan (MIP) containing the applicant's procedures for reporting and responding to launch and reentry accidents, launch and reentry incidents, or other mishaps, as defined in §401.5 of this

**Deleted:** and reentry

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**Commented [AC11]:** Remove confusion by not using term "safety approval"

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**Deleted:** (3) That ensure conformance with operational restrictions listed in paragraphs (c) through (e) of this section;¶

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**Commented [AP12]:** Submit plan in license application; submit actual analysis in L-15d Notice of Mission report.

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**Deleted:** For ~~an RLV~~ all licensed missions—

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**Commented [AP13]:** Capture 431.43(c)(4) in guidance; USAF, NASA requirements in guidance

**Deleted:** (4) Vehicle safety operations personnel shall adhere to the following work and rest standards:¶
(i) A maximum 12-hour work shift with at least 8 hours of rest after 12 hours of work, preceding initiation of an ~~RLV~~ reentry mission or during the conduct of a mission;¶
(ii) A maximum of 60 hours worked in the 7 days, preceding initiation of an ~~RLV~~ mission;¶
(iii) A maximum of 14 consecutive work days; and ¶
(iv) A minimum 48-hour rest period after 5 consecutive days of 12-hour shifts.¶

**Commented [AP15]:** Change language to clarify that applicant can submit whatever combination of documents they want (or only one document) to address mishaps, incidents, accidents, emergencies, investigations, etc. (417.45(d) and (e) should be combined)

chapter, that occur during the conduct of ~~an RLV~~ a mission. An acceptable MIP satisfies the requirements of paragraphs (b)(d) of this section. An applicant shall also submit an emergency response plan (ERP) that contains procedures for informing the affected public of a planned ~~RLV~~ mission. An acceptable ERP satisfies the requirements of paragraph (e) of this section. The MIP and ERP shall be signed by an individual authorized to sign and certify the application in accordance with §413.7(c) of this chapter, a person responsible for the conduct of all licensed ~~RLV~~ mission activities designated under §431.33(b) of this subpart, and a safety official designated under §431.33(c) of this subpart.

(b) *Report requirements.* A MIP shall provide for—

(1) Immediate notification to the FAA Washington Operations Center in case of a launch or reentry accident, launch or reentry incident, or a mishap that involves a fatality or serious injury (as defined in 49 CFR 830.2);

(2) Notification within 24 hours to the Associate Administrator for Commercial Space Transportation in the event of a mishap that does not involve a fatality or serious injury, as defined in 49 CFR 830.2; and

(3) Submission of a written preliminary report to the FAA Associate Administrator for Commercial SpaceTransportation in the event of a launch accident or launch incident occurring in the conduct of an ~~RLV~~ mission, or reentry accident or reentry incident, occurring in the conduct of ~~an RLV~~ a mission, within 5 business days of the event. The report shall identify the event as either a launch or reentry accident or incident and must include the following information:

(i) Date and time of occurrence;
(ii) Description of the event and sequence of events leading to the accident or incident, to the extent known;
(iii) Intended and actual location of launch and reentry or other landing on Earth;
(iv) Identification of the vehicle;
(v) Identification of the payload, if applicable;
(vi) Number and general description of any fatalities and injuries;
(vii) Property damage, if any, and an estimate of its value;
(viii) Identification of hazardous materials, as defined in §401.5 of this chapter, involved in the event, whether on the vehicle, payload, or on the ground;
(ix) Action taken by any person to contain the consequences of the event;
(x) Weather conditions at the time of the event; and
(xi) Potential consequences for other vehicles or systems of similar type and proposed operations.

(c) *Response plan.* A MIP must contain procedures to—

(1) Ensure the consequences of a launch accident, launch incident, reentry accident, reentry incident, or other mishap occurring in the conduct of ~~an RLV~~ a mission are contained and minimized;

(2) Ensure data and physical evidence are preserved;

**Commented [AP16]:** There should no longer be one identified flight director and safety officer for a vehicle program. There should be as many as the applicant wants and the people assigned those positions for the upcoming mission should be identified in the L-15d notification.

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**Commented [AC17]:** Exclude property of licensee

(3) Require the licensee to report and to cooperate with FAA and the National Transportation Safety Board investigations and designate ~~one or more points~~ at least one point of contact for the FAA or NTSB; and;

(4) Require the licensee to identify and adopt ~~preventive measures for avoiding~~ corrective actions to avoid recurrence of the event.

(d) *Investigation plan.* A MIP shall contain—

(1) Procedures for investigating the cause of an event described in paragraph (c)(1) of this section;

(2) Procedures for reporting investigation results to the FAA;

(3) Delineated responsibilities, including reporting responsibilities, for personnel assigned to conduct investigations and for any unrelated entities retained by the licensee to conduct or participate in investigations.

(e) *Emergency response plan.* An ERP shall provide for—

(1) Notification to local officials in the event of an offsite or unplanned landing so that vehicle recovery can be conducted safely and effectively and with minimal risk to public safety. The plan must provide for the quick dissemination of up-to-date information to the public~~, and for doing so in advance of~~ prior to reentry or other landing on Earth to the extent practicable; and

(2) A public information dissemination plan for informing the potentially affected public~~, in laymen's terms and in advance of a planned reentry,~~ of the estimated date, time, and landing location ~~for the~~ of reentry activity.

**§431.77(b) Records.**

(b) In the event of a launch accident, reentry accident, launch incident or reentry incident, as defined in §401.5 of this chapter, a licensee shall preserve all records related to the event. Records must be retained until completion of any Federal investigation and the FAA advises the licensee that the records need not be retained. The licensee shall make all records required to be maintained under the regulations available to Federal officials for inspection and copying.

**§431.79(c) License reporting requirements**

Deleted: Reusable launch vehicle mission

(c) A licensee must report a launch accident, launch incident, reentry accident, reentry incident, or other mishap immediately to the FAA Washington Operations Center and provide a written preliminary report in the event of a launch accident, launch incident, reentry accident, or reentry incident, in accordance with the mishap investigation and emergency response plan submitted as part of its license application under §431.45.

**§431.75 Agreements.**

(a) *Launch and reentry site use agreements.* Before conducting a licensed ~~RLV~~ mission using property or services of a Federal launch range or licensed launch or reentry site operator, a licensee or applicant shall enter into an agreement with the Federal launch range and/or licensed site operator that provides for access to and use of property and services required to support a licensed ~~RLV~~ mission ~~or reentry~~ and for public safety related operations and support. The agreement shall be in effect before any licensed ~~RLV~~ mission ~~or reentry~~. A licensee shall comply with any requirements of the agreement that may affect public health and safety and the safety of property during the conduct of its licensed activity.

(b) *Agreements for notices to mariners and airmen.* Unless otherwise addressed in agreements between a licensed launch site operator and the U.S. Coast Guard and the FAA, respectively, a licensee authorized to conduct ~~an RLV~~ a mission using a launch site or reentry site other than a Federal launch range shall complete the following:

(1) An agreement between the licensee and the local U.S. Coast Guard district to establish procedures for the issuance of a Notice to Mariners prior to a launch or reentry and other measures as the Coast Guard deems necessary to protect public health and safety; and

(2) An agreement between the licensee and the FAA regional office having jurisdiction over the airspace through which a launch and reentry will take place, to establish procedures for the issuance of a Notice to Airmen prior to the conduct of a licensed launch or reentry and for closing of air routes during the respective launch and reentry windows and other measures deemed necessary by the FAA regional office in order to protect public health and safety.

## Subpart J – Module 9: Ground Safety

Approach: Performance metric or ground safety should be 1 x 10-6 and follow a process similar to that described in §417.411.

To facilitate a performance based approach, portions of the following regulations could be used in guidance documents to further inform the ground safety analysis.

- §420.15
- §420.53
- §415.103
- §415.117
- §417.109

## Subpart K – Module 10: Environmental

**§431.91 General.**

An applicant shall provide the FAA with sufficient information to analyze the environmental impacts associated with proposed operation of ~~an RLV~~ a vehicle, including, where applicable, the impacts of anticipated activities to be performed at its reentry site. The information provided by an applicant must be sufficient to enable the FAA to comply with the requirements of the National Environmental Policy Act, 42 U.S.C. 4321 *et seq.,* the Council on Environmental Quality Regulations for Implementing the

**Commented [AC18]:** Or, in cases like KSC or non Federal Ranges that could use Federal Range support services

**Deleted:** and

Procedural Provisions of the National Environmental Policy Act, 40 CFR parts 15001508, and the FAA's Procedures for Considering Environmental Impacts, FAA Order 1050.1D. Copies of FAA Order 1050.1D may be obtained from the Office of Environment and Energy, AEE300, Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20591, (202) 2673553. Copies of FAA Order 1050.1D may be inspected in the Rules Docket at the Federal Aviation Administration, Office of the Chief Counsel, AGC200, Room 915G, 800 Independence Avenue SW., Washington, DC 20591 weekdays between 8:30 a.m. and 5:00 p.m.

**§431.93 Environmental information.**

An applicant shall submit environmental information concerning—

(a) A designated launch and reentry site, where applicable, including contingency abort locations, if any, not covered by existing FAA or other Federal environmental documentation;

(b) A proposed new ~~RLV~~ vehicle with characteristics falling measurably outside the parameters of existing environmental documentation;

(c) A proposed reentry to an established reentry site involving ~~an RLV~~ vehicle with characteristics falling measurably outside the parameters of existing environmental impact statements covering that site;

(d) A proposed payload that may have significant environmental impacts in the event of a launch or reentry accident; and

(e) Other factors as necessary to comply with the National Environmental Policy Act.

**CODE OF FEDERAL REGULATIONS**

**Title 14 → Chapter III → Subchapter C → Part 499**

**Title 14: Aeronautics and Space**

**PART 499—Post Licensing & Inspection**

AUTHORITY: 51 U.S.C. 5090150923.
SOURCE: Docket No. FAAxxxxxx



Deleted: Reusable launch vehicle m

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**§431.39 Mission rules, procedures, contingency plans, and checklists.**

(c) Vehicle safety operations personnel must have current and consistent mission checklists.

**§431.43 Mission operational requirements and restrictions.**

(c) For an RLV mission—

(1) Licensee shall submit to FAA a collision avoidance analysis showing at least a 200-kilometer separation from any inhabitable orbiting object during launch and reentry. The analysis shall address:

(i) For launch, closures in a planned launch window for ascent to outer space or, for an orbital RLV, to initial orbit through at least one complete orbit;

(ii) For reentry, the reentry trajectory;

(iii) Expansions of the closure period by subtracting 15 seconds from the closure start-time and adding 15 seconds to the closure end-time for each sequential 90 minutes elapsed time period, or portion thereof, beginning at the time the state vectors of the orbiting objects were determined;

**§431.77 Records.**

(a) Except as specified in paragraph (b) of this section, a licensee shall maintain for 3 years all records, data, and other material necessary to verify that a licensed RLV mission is conducted in accordance with representations contained in the licensee's application.

**§431.79 Mission reporting requirements.**

(a) Not less than 15 days before each mission conducted under a license, a licensee shall provide the FAA with the following information:

(1) Final Payload manifest information <insert requirements of 431.57>; and

(2) Flight information, including the vehicle, launch site, planned launch and reentry flight path, and intended landing sites including contingency abort sites.

(3) Launch or reentry waivers, approved or pending, from a Federal range from which the launch or reentry will take place, that are unique and may affect public safety.

(4) The time and date of the intended launch and reentry or other landing on Earth and may utilize the FAA/U.S. Space Command Launch Notification Form, for doing so.

(5) the Mission Director and Safety Officer assigned to the operation.

(c) A licensee must report a launch accident, launch incident, reentry accident, reentry incident, or other mishap immediately to the FAA Washington Operations Center and provide a written preliminary report in the event of a launch accident, launch incident, reentry accident, or reentry incident, in accordance with the mishap investigation and emergency response plan submitted as part of its license application.

**§431.81 Financial responsibility requirements.**

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Deleted: (b) Not later than 15 days before each licensed RLV mission, a licensee must notify the FAA, in writing, of t

Deleted: of the RLV

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Deleted: under §431.45

A licensee under this part must comply with financial responsibility requirements specified in its license.

**§431.83 Compliance monitoring.**

Deleted: A licensee shall allow access by, and cooperate with, Federal officers or employees or other individuals authorized by the FAA to observe any activities of the licensee, or of the licensee's contractors or subcontractors, associated with the conduct of a licensed RLV mission.

New Recommended Approach:

- Inspection activities limited to:
  - Verifying licensee's system safety case;
  - Operations aspects implicating public safety or safety of property;
  - Those activities that fall within the definition of "licensed activities";
- Opportunities to observe other activities for inspector training/familiarization purposes at operators discretion
- Licensee shall provide inspectors with real time access to operations and test procedures

**§431.85 Registration of space objects.**

(a) To assist the U.S. Government in implementing Article IV of the 1975 Convention on Registration of Objects Launched into Outer Space, each licensee shall provide to the FAA the information required by paragraph (b) of this section for all objects placed in space by a licensed RLV mission, including an RLV and any components, except:

(1) Any object owned and registered by the U.S. Government; and

(2) Any object owned by a foreign entity.

(b) For each object that must be registered in accordance with this section, a licensee shall submit the following information not later than thirty (30) days following the conduct of a licensed RLV mission :

(1) The international designator of the space object(s);

(2) Date and location of the RLV mission initiation;

(3) General function of the space object; and

(4) Final orbital parameters, including:

(i) Nodal period;
(ii) Inclination;
(iii) Apogee; and
(iv) Perigee.

(c) A licensee shall notify the FAA when it removes an object that it has previously placed in space.

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**CODE OF FEDERAL REGULATIONS**

**Title 14 → Chapter III → Subchapter C → Part 413**

**Title 14: Aeronautics and Space**

**PART 413 – License Application Procedures**

AUTHORITY: 51 U.S.C. 5090150923.
SOURCE: Docket No. FAAxxxxxx

**§413.5 Pre-application consultation.**

A prospective applicant may consult with the FAA before submitting an application to discuss the application process and possible issues relevant to the FAA's licensing or permitting decision. Early consultation helps an applicant to identify possible regulatory issues at the planning stage when changes to an application or to proposed licensed or permitted activities are less likely to result in significant delay or costs to the applicant.

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**§413.7 Application**

(Add the following as 413.7(f))

(f) Identify foreign ownership of the applicant as follows:

(1) For a sole proprietorship or partnership, identify all foreign ownership;

(2) For a corporation, identify any foreign ownership interests of 10% or more; and

(3) For a joint venture, association, or other entity, identify any participating foreign entities.

**§413.11 Acceptance of an application.**

For license applications under Part 489, the FAA will initially screen an application module to determine whether that module is complete enough for the FAA to start its review. The FAA will complete this initial screen within seven (7) days of receipt of the application module. After completing the initial screening, the FAA will notify the applicant in writing of one of the following:

Commented [AP19]: Will need to include procedures for experimental permit, spaceport license, safety approval.

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(a) The FAA accepts the application module and will initiate the reviews required to make a decision about the license or permit; or

(b) The application module is so incomplete or indefinite that the FAA cannot start to evaluate it. The FAA will reject it and notify the applicant, stating each reason for rejecting it and what action the applicant must take for the FAA to accept the application module.

Deleted: The FAA may return a rejected application to the applicant or may hold it until the applicant takes the required actions.

Failure by the FAA to notify an applicant of its complete enough determination within seven days of receipt of an application module means that an application has been accepted by the FAA.

**§413.15 Review period.**

(a) *Review period duration.* FAA reviews and makes a determination on a license application module under Part 489 in 30 days. If an applicant submits modules simultaneously, review time is no more than 60 days for 2 modules, and no more than 90 days for 3 or more modules submitted.

(b) *Review period tolled.* If an accepted application module does not provide sufficient information to continue or complete the reviews or evaluations required by this chapter for a licensing or permitting determination, or an issue exists that would affect a determination, the FAA notifies the applicant, in writing, and informs the applicant of any information required to complete the application. If the FAA cannot review an accepted application because of lack of information or for any other reason, the FAA will toll the 180-day or 120-day review period until the FAA receives the information it needs or the applicant resolves the issue.

(c) *Notice.* If the FAA does not make a decision within 60 days of receiving an accepted license application module or within 90 days of receiving an accepted permit application, the FAA informs the applicant, in writing, of any outstanding information needed to complete the review, or of any issues that would affect the decision.

**§413.17 Continuing accuracy of application; supplemental information; amendment.**

Add: An applicant must amend the content of its license application when the proposed amendment amounts to a "material change."

Add definition of "Material Change" – a change that impacts public health & safety or the safety of property as proven through an applicant's safety case; a material change will introduce new hazards that impact Ec or impact the payload or policy review.

Add: Proposed amendments under consideration do not prevent the operator from continuing operations under an existing authorization.

(a) As part of this submission, the applicant must recertify the accuracy and completeness of the application under §413.7. If an applicant does not comply with any of the requirements set forth in this paragraph, the FAA can deny the license or permit application.

(b) An applicant may amend or supplement a license or permit application at any time before the FAA issues or transfers the license or permit.

(c) Willful false statements made in any application or document relating to an application, license, or permit are punishable by fine and imprisonment under section 1001 of Title 18, United States Code, and by administrative sanctions in accordance with part 405 of this chapter.

**§431.47 Denial of approval.**

The FAA notifies an applicant, in writing, if the FAA has denied approval for a submitted application. The notice states the reasons for the FAA's determination. The applicant may respond to the reasons for the determination and request reconsideration.

**Commented [AP20]:** We plan to advocate for a change to the statute to remove the statutory 180 day requirement.

**Deleted:** Unless otherwise specified in this chapter, the FAA reviews and makes a decision on an application within 180 days of receiving an accepted license application or within 120 days of receiving an accepted permit application.

**Deleted:** 120

**Commented [AP21]:** Keep amendment requirements in Part 413 instead of in licensing parts (e.g., delete 431.73)

**Deleted:** An applicant must ensure the continuing accuracy and completeness of information furnished to the FAA as part of a pending license or permit application. If at any time the information an applicant provides is no longer accurate and complete in all material respects, the applicant must submit new or corrected information.

**Commented [AP22]:** Instead of repeating this numerous times throughout all of the licensing modules, just state it once up front.

**Deleted:** **safety**

**Commented [AP23]:** Could also specify "a license application module, an experimental permit, a safety approval, a launch site operator license…"

**Deleted:** safety

**Deleted:** n RLV

**Deleted:** mission license

## Addition Comments on 14 CFR §401.5 Definitions

"Launch," "Beginning of Launch," "End of Launch"

- Industry proposes to delete the *Beginning of launch* and *End of launch* portions of the definition of *Launch* as currently contained in 14 CFR §401.5 and to revise the remainder of the definition as follows:
    - *Launch* means to place or try to place a launch vehicle or reentry vehicle and any payload from Earth in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space, and includes preparing a launch vehicle for flight at a launch site in the United States. Launch includes the flight of a launch vehicle and includes pre- and post-flight ground operations ***so publicly hazardous as to warrant FAA's regulatory oversight, as defined in the license or permit***. (emphasis added to show proposed change from current definition.)
- "Activities so hazardous as to warrant FAA's regulatory oversight" would be those activities not already regulated by another government entity (federal, state or local), and AST and the applicant would determine the appropriate coverage for the definition given the unique aspects of their technology and operations.

"Safety of Property"

- This phrase is used throughout the Part 400 regulations. This phrase deserves clarification that this refers to safety of third party and USG property, not property of the licensee, contractors, or customers involved in the operation.
- We realize this could be interpreted to require a statutory change, which we are eager to pursue, however, we also think justification can be provided that allows FAA to clarify this statutory requirement through its regulations, given the policy behind the CSLCA's risk regime.

# Recommended Licensing Guidance List

1) **System Safety**
   a) Contents of "Building System Safety Case" submitted by industry during Streamlining ARC
      i) Outlines acceptable approaches to developing a system safety case based on a level of rigor approach
   b) Contents of 417.107
2) **Vehicle Description**
   a) Submission Form
      i) Fill-in form/templates that contains the minimum required information regarding a vehicle description
3) **Flight Safety Analysis**
   a) Safety Critical Systems and Events
      i) Guidance on an acceptable means of evaluating and determining safety critical hardware on a spacecraft from the perspective of public safety. Also touches on how to determine safety critical events
   b) Trajectory Development Guidance
      i) Defines time steps, when to begin/end analysis, required parameters and units, etc.
   c) Re-Contact Analysis
      i) Acceptable means of conducting a re-contact analysis
4) **Payload Review**
   a) Submission form
      i) Fill-in form(s) that contains the minimum set of information needed to conduct a payload review
   b) Document that gives guidance on classes of PLs and examples
5) **Policy Review**
   a) Description document of how the review process works
6) **Operational Restrictions**
7) **Safety Organization**
   **a)** Fill-in form with minimum information required to be submitted about the safety official(s)
8) **Operations**
   a) Notice of Mission Submission Form
      i) Fill-in form that contains the needed information, fidelity, and units of data to provide adequate notice of mission to the FAA
   b) Include 415 Appendix A (Space Command Template) in a guidance document
   c) Recommend 417.117(g) be placed in a guidance document
   d) Capture 431.43(c)(4) in guidance; USAF, NASA requirements in guidance
   e) Capture 417.113(f) in guidance
   f) LOA templates
      i) Fill-in forms/templates that contain the minimum information needed to be compliant with the requirement for airspace, launch/reentry site, and coast guard LOAs
9) **Ground Safety**
10) **Environmental Assessment**
   a) Sonic Boom Analysis
      i) Details acceptable fidelity of analysis inputs and defines needed psf contours needed to be reported in the sonic boom analysis.

## Appendix F – Concurrences

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| **Voting Member:** | Sharon L Pinkerton |
| **Company** | Airlines for America |
| **Date Received:** | 4/30/2018 |
| **Response:** | Non-concur |

The FAA's statutory mission is ensuring the safety and efficiency of the NAS. When the FAA chartered this ARC, the scope of the ARC was limited to safety issues. No application for a launch site license should be approved until a determination is made that doing so will not negatively impact the regional airspace. Currently, passengers are being negatively impacted by launches, and this disruption will only increase with the growth of the commercial space industry. Shutting down swaths of busy airspace for extended periods of time will not ensure the most efficient use of the airspace. That's why the location of a launch site is critical and one factor in launch site application approval should be proximity to busy airspace.

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| **Voting Member:** | Mark Greby |
| **Company Name:** | AAC |
| **Date Received:** | April 30, 2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | Audrey Powers |
| **Company Name:** | Blue Origin |
| **Date Received:** | 4/30/2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | Lisa Loucks |
| **Company Name:** | Boeing |
| **Date Received:** | 04/30/2018 |
| **Response:** | Final Position |

We have reviewed the final report (version 4.2) of the FAA Streamlined Launch and Reentry Licensing Aviation Rulemaking Committee (ARC) to assess updates since out last ARC position transmittal on Thursday April 26th. Despite submitting comments/suggestions there are remaining unresolved issues, ambiguities, and differences. Overall our position remains a provisional "concur" based on individual (9) concur and (5) non-concur positions to the fourteen questions as noted below.

We are vehemently opposed to the ARC submitting any draft regulatory language through the ARC report process as the overall ARC is recognized as a consensus effort. The language was created by less than twenty percent of the ARC participants and was not performed in an inclusive manner. The efforts should not be misrepresented as being created by a proper ARC task group or working group. The language under consideration was only shared with the larger ARC very late in the process and did not leave time to conduct the necessary due diligence. We support the continued refinement of the draft regulatory language in question for a future ARC submittal to the FAA and recommend continued ARC activities to properly address this language in a true working group consensus fashion.

1. Concur
2. Concur
3. Non-concur – (we don't support lowering the current standards for testing flight safety systems, and there is no suggested new system qualification guidance)
4. Non-concur – (a flight safety system is required for high consequence events despite low probability, unless other controls can sufficiently demonstrate dual failure tolerance)
5. Concur
6. Non-concur – (disagree with the approach to allocate risk to separate mission phases)
7. Concur
8. Concur
9. Concur
10. Concur
11. Non-concur - (conflicts with original clarifications regarding public safety)
12. Concur
13. Concur
14. Non-concur (two opposing comments have not been resolved)

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| **Voting Member:** | Mary Lynne Dittmar |
| **Company Name: (Association)** | Coalition for Deep Space Exploration (CDSE) |
| **Date Received:** | 4/30/18 |
| **Response:** | Non-concur due to insufficient time for review, absence of consensus among CDSE members, and inclusion of draft regulatory language |

CDSE appreciates the opportunity to observe and participate in the Streamlined Launch and Reentry Licensing Aviation Rulemaking Committee (ARC). CDSE supports and agrees with the intent to update and streamline regulations and looks forward to continued opportunity to review and to engage with the FAA as the rulemaking process continues. Further, we commend our members and all of industry for their hard work and diligence in developing consensus to the extent that it has emerged in such a short time frame.

That said CDSE can neither concur nor non-concur on the entire range of answers to the FAA questions and therefore cannot concur on the report at this time, due to insufficient review time stemming from a delay – sometimes lengthy - in bringing some CDSE members into the process. In addition CDSE does not concur on inclusion of any draft regulatory text (Appendix E). While we appreciate the attempt to "sequester" the draft regulations, we have determined that their inclusion in the report language in any form implies that they represent part of the ARC process, which they do not. While we appreciate the effort of the companies involved, they are acting independently. As a result the language has not been vetted by the ARC membership, does not represent the ARC as a whole, and should not be included as part of the ARC final report.

We look forward to continuing to work with the FAA via the ARC process provided representation of stakeholders from the onset is ensured and welcome opportunity to participate in drafting regulatory language provided sufficient time is provided to engage in the process.

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| **Voting Member:** | Eric Stallmer |
| **Company Name:** | Commercial Spaceflight Federation |
| **Date Received:** | 4/30/2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | John Quinn |
| **Company Name:** | Exos Aerospace Systems & Technologies, Inc. |
| **Date Received:** | April 30th 2018 |
| | • I concur with the final report as written, with the following exception(s):<br>1. Crew Rest should be a function of role and physical workload and should be managed by the Employer not arbitrary rules that unduly burdens innovative small businesses. Such regulatory framework provides a competitive advantage to big business and adds to the risk profile for small business as small companies are forced to hire temps to comply with rest rules and sideline the experts.<br>2. The Autonomous Flight Termination Unit (AFTU) Qualification Testing Requirements **example** table presented should be recognized as an Orbital vehicle "template / example" and not as a prescriptive set of requirements for any vehicles performance based acceptance. We caution that use of this "sample" in regulatory language could defeat the intent of avoiding prescriptive requirements that potentially constrain innovative approaches and require testing beyond what suppliers (the specific equipment experts) already do to sell their hardware. Such regulation would have significant small business impact. |
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| **Voting Member:** | Bill Doncaster |
| **Company Name:** | Generation Orbit |
| **Date Received:** | 4/30/2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | Jennifer Warren |
| **Company Name:** | Lockheed Martin Corporation |
| **Date Received:** | 30 April 2018 |
| **Response:** | I concur with the following exceptions |

Lockheed Martin concurs with the ARC Responses to the FAA Follow-Up Questions, with the exception of those answers noted below. Lockheed Martin has suggested changes which would address our non-concurrence concerns in some instances, and provided explanations for concerns in others.

Lockheed Martin supports flexibility, but an options based approach; modifications proposed to achieve this.

1) Page 3, System Safety, Question (a). The ARC states that the system safety process should form the core of the FAA requirements.

*Follow-up Question:* Does the ARC recommend that the system safety process be required for all launch and reentry scenarios and all flight phases, or would other safety approaches be acceptable in some circumstances? If so, please elaborate.

Applicants should have the option of using a system safety-based licensing process for launch and reentry applications. ~~Yes, the assessment of an applicant's system safety process should be required for all launch and reentry scenarios and all flight phases.~~ A process for identifying hazards ~~under all scenarios and flight phases~~ that determines severity and likelihood, and identifies appropriate hazard control and verification strategies, is the current best practice to ensure a comprehensive safety case. A risk-based licensing strategy will enable ~~However, there should be~~ flexibility in designs and hazard control strategies. For example, a vehicle operating in an unpopulated area, contained by physics, may not need any other controls beyond ensuring that the operating area is sufficiently sized, and that public access is restricted. See the recommended approach attached, "Building a Safety Case for FAA Licensing Purposes."

Non-Concurrence, subject to Modification for consistency with modification to above response.

2) Page 4, System Safety, Question (e). The ARC states that the FAA should initiate a comprehensive review of an applicant's system safety processes at the start of the pre-application consultation phase to define the appropriate level of rigor for that applicant or vehicle program.

*Follow-up Questions:*

a) What data should the applicant provide the FAA for this purpose?

If an applicant pursues a system safety-based licensing process, ~~T~~the applicant should provide a complete description of their hazard identification and control process in a document such as a System Safety Program Plan or equivalent. The applicant should also provide a system-level PHA or FHA, a summary of company history, a summary of vehicle heritage and any applicable flight history, a description of populated areas potentially affected by vehicle operations, and a complete description of all inert, explosive, and toxic hazards associated with the vehicle design. The applicant should include a description of how each of these pieces of data or outputs is used in the overall system safety process. An applicant should also describe how they audit this process.

b) How could the requirements be written to avoid the need for extensive negotiations between the FAA and applicant, like is currently required today under 14 CFR part 431?

Recommend developing a licensing requirements matrix following a structure similar to NASA's "Launch Vehicle Certification Requirements Matrix" in NPD 8610.7D in order to make vehicle and operator categorization explicit. See the recommended approach attached, "Building a Safety Case for FAA Licensing Purposes." Determination of vehicle and operator categorization should be the primary purpose of pre-application consultation.

Non-Concurrence, subject to Modifications. While we generally support the broader recommendation, we cannot concur with the 3rd option being included; LM cannot support it as a valid option, without knowing what the "to be developed" guidance is that would be used in place of the existing requirements is – particularly since this relates specifically to new systems without heritage (i.e. inherently higher risk systems).

3) Page 5, Flight Safety Systems, Question (b)(ii). The ARC states that the variables that go into a flight safety analysis should be used to determine what the required reliability of an FSS should be.

*Follow-up Question:* How should an applicant demonstrate the reliability of a flight safety system that does not otherwise meet RCC-319 like standards?

3 different approaches ~~that are valid~~could be implemented (including the RCC-319 option mentioned in the question):

- Systems with previous qualification to RCC-319/AFSPCMAN91-710/Part 417, and approved for use at a major launch site, are usable at any launch site without further testing as long as the environments are encompassed by the existing qualification and there are no range-specific environments (EMI/EMC exposure, salt fog, etc.) that were not covered by the original qualification.
    - This should apply to systems that have been previously approved for use on vehicles at KSC, CCAFS, VAFB, and Wallops, additional review may be required for other launch sites that may have different requirements due to geographic or other considerations.
    - While focused on heritage systems, this path should remain open for any user that prefers to follow the existing style of requirements for new or revised systems.
- For heritage systems with extensive flight experience (i.e. flight of > 50 units), demonstrated flight/operational reliability, when combined with a bottom's up reliability analysis, and a streamlined qualification to the predicted environments should provide sufficient confidence in heritage systems. This approach is aimed for using units~~,~~ such as the HFTR-60 receivers which are regularly used on any number of atmospheric and space launches. Qualification testing should be performed on a single unit per SMC-S-016 or an equivalent standard (including thermal, vibration, and shock testing) to ensure that the unit is suitable for the intended environments; EMI/EMC testing also should be performed per MIL-STD-461, but this will often be satisfied by previously conducted testing. (Still mulling over how much of the heritage system would need to be implemented on a new vehicle for the new vehicle to benefit from the reduced single unit qual test approach.)
- ~~For new systems without extensive heritage, following of, still to be developed, performance based guidance documentation~~.

Non-Concurrence, subject to Modifications. Lockheed Martin recommends a stronger statement on the requirement as modified below.

4) Pages 5 and 6, Flight Safety Systems, Questions (a) and (b). The ARC states that a flight safety system should not be required; instead, an operator should be required to meet the allowed risk calculations in the Flight Safety Analysis, and that the current expected casualty requirements would be an appropriate performance for flight safety.

*Follow-up Question*: A flight safety system is typically used to meet collective Ec and individual risk criteria and to prevent low probability, high consequence events to the public. Given the uncertainties associated with the inputs (e.g., probability of failure) of a flight safety analysis, how does the ARC propose an operator protect against low probability, high consequence events without a flight safety system?

- ~~First, it is not responsibility or place propose alternatives in this ARC; rather, the point of the regulation is to allow for such means should they be developed in the future. That said,~~ Tthere are multiple means of debris containment. Flight path (not flying over populated areas); thrust termination; flight pedigree (where reliability data proves that it's actually more hazardous to have ordnance attached). Vehicles could utilize the flight computer to recognize boundaries and trigger existing vehicle systems to take safety measures (like thrust termination). ~~Keep in mind that ordnance also has an effect on commercial spaceflight; participants will appreciate not having extra bombs strapped to the rocket.~~
- ~~Recommend the operator have an adequate sample size to support the allowed risk calculations in the Flight Safety Analysis.~~

There does not need to be a dedicated FSS in the traditional sense that follows the requirements for a traditional system. Any vehicle that is capable of creating low probability, high consequence events to the public should still include protections and mitigations driven by the systems safety approach to vehicle design. The intent is to provide flexibility in the implementation, but examples include propellant dumping, flight health monitoring, or operational mitigations. Applicants who pursue alternate FSS systems should be required to provide an adequate sample size to support the allowed risk calculations in the Flight Safety Analysis.

Non-Concurrence, subject to elimination of 2nd bullet – overly broad exclusion.

5) Pages 6 - 7, Flight Safety System, Question (c). The ARC states that the FAA should scale required verification requirements by vehicle and operator category and relative risk. Categories could include new vehicle by new operator, proven vehicle by experienced operator, derived vehicle by experienced operator, vehicle hazard class, and sparsely or densely populated area

04/28/18

*Follow-up Question:* What would the ARC recommend as appropriate metrics and thresholds to establish and distinguish between classes of operator experience, vehicle hazard, and public exposure?

- Number of flights; flight performance data; flight profiles; vehicle components and materials.
- ~~Recommend that an operator that was using an established system safety process that the FAA had already approved would not need to start from scratch getting that process approved for a subsequent vehicle.~~
- In the matrix approach presented in attached "Building a Safety Case for FAA Licensing Purposes" the input parameters could be for example, three successful flights should distinguish an experienced operator from a new operator, vehicle casualty area greater than X should determine vehicle hazard class (where X is based on a potential mass casualty event), and public exposure should be based on probability of impact to a populated area (1E-04 to 1E-06) as a baseline and population density (establish categories from 1 to 100,000 persons per square mile). Alternatively, identify a specific threshold for vehicle size, mass, or TNT equivalency and to differentiate between orbital and suborbital vehicles.

Non-Concurrence for Q10-11 Responses - This requires a potential for securing cross-waivers from neighboring ops, and we don't envision that as workable. We do not concur with the categorical exclusion of neighboring ops (personnel or property) from the MPL. However, personnel may be excluded if the time of day of launch is when there is no personnel on the relevant premises.

10) Page 30, Definition of Public Safety, Question (a). The ARC recommends that permanently badged personnel on a launch or reentry site not be considered "public."

*Follow-up Question*: For the Air Force, neighboring operations personnel (NOP) are individuals, not associated with the specific operation or launch currently being conducted, but are required to **perform safety, security, or critical tasks at the launch base**, and who are notified of a neighboring hazardous operation and are either trained in mitigation techniques or accompanied by a properly trained escort. The NOP may include individuals performing launch processing tasks for another launch, but **do not include individuals in training for any job or individuals performing routine activities such as administrative, maintenance, support, or janitorial**. NASA has a similar definition for NOP as the Air Force, but refers to them as Critical Operations Personnel. Some trainees, administrative, maintenance, support, and janitorial personnel on a site are likely to be permanently badged. Should these individuals be considered "public"? If not, why?

When the FAA asked industry whether there should be a revised definition of "Public Safety" as it currently exists in §401.5, industry representatives reviewed FAA's statutory charge from Congress codified in Chapter 509. Industry considered how FAA has interpreted that charge as reflected in the current definition of "public safety" in the regulations. Industry does not believe it was constrained to only consider the FAA example of Neighboring Operations Personnel (NOP) as currently defined in policy (not regulation) by the Air Force. The consensus of industry was that the definition contained in regulations should be revised to align with the statutory responsibility, and focus FAA's regulatory oversight on its statutory responsibility to "protect the public health and safety" cited in the purpose of Chapter 509. Industry believes the current definition inappropriately extends the function of protecting "public safety" to issues more accurately characterized as "industrial safety" for those who work within the controlled boundaries of launch and reentry sites/spaceports. Personnel that are permanently badged, or similarly credentialed for access to controlled areas, are trained in the nature of the hazards which are or may be present, and/or properly escorted by trained personnel. They are not the public. Both hazard and non-hazard areas should be managed and controlled by the host installation (federal or commercial spaceport) and by the launch operators on the site to facilitate both workforce safety and site security. They can accomplish those objectives without a need for FAA regulatory prescription and oversight. Industry believes it is FAA's statutory role to protect public health and safety, not to regulate industrial ground safety for personnel that work at launch and reentry sites.

11) Page 31, Definition of Public Safety, Question (c). As a mitigation for uninvolved neighboring operations personnel when a hazardous operation or launch is scheduled, the ARC suggested that potential reciprocal waivers may be entered into among neighbors to share risks of hazards to each other's property and personnel.

*Follow-up Question*: Does the ARC believe that FAA insurance requirements would then not need to apply to neighboring operations personnel?

The FAA specifically excluded Part 440 Financial Responsibility from the scope of this ARC. There are many questions industry has previously presented to FAA for clarification of Part 440. Among those are the appropriate role of non-regulated insurance and risk-sharing arrangements entered into between operators, and between operators and their host site. In general, without being able to assess the FAA's response to those questions, this follow-up question must be answered in the context of a notional regulatory regime in which operators are free to indemnify one another, and their host site operator/land owner via cross waivers or assumption of risks agreements. These would represent an explicit acceptance of the identified risks of a neighboring operation/launch. In the absence of such an agreement, the neighboring operators would comply with the applicable safety-clear rules of the site operator. In this scenario, operations personnel of an uninvolved operator remaining in the hazard area of a neighboring or nearby operator would not be considered in the safety criteria for initiating a launch, criteria intended to ensure an acceptable level of safety to the uninvolved public. These people would not be included in the MPL calculation driving financial responsibility requirements under Part 440. Property owned by neighboring operators, if not encumbered with third party stakeholders/owners, would also be excluded from FAA-regulated and required insurance IF the property is also covered by operator-to-operator and operator-to-host site allocation of risk agreements.

Non-concurrence - Direct Reporting is not a burden within an established culture of safety, but actually reflective of that safety culture.

14) Page 39, Safety Organization and Personnel Qualifications, Question (a). The ARC recommends that the FAA remove the direct reporting structure of the Safety Official.

*Follow-up Question:* The direct reporting structure of the Safety Official is designed to ensure that safety concerns are addressed independently of mission assurance and that those concerns are conveyed to the person in charge of licensed launches. Does the ARC recommend an alternative means to provide safety independence?

- ~~New wording, which can be added during our re-writing meetings, should replace "direct report" with "direct line of communication." A direct reporting structure is not necessary to ensure public safety and the intent can be met by various organizational arrangements.~~
- Recommend no change in the current Safety Official direct reporting structure. Direct reporting of an independent safety function ~~the safety official~~ is an industry standard and does not induce any burden for an operator with an established ~~functional~~ safety ~~organization and~~ culture.

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| **Voting Member:** | Michael Lopez-Alegria |
| **Company Name:** | MLA Space, LLC |
| **Date Received:** | 4/28/2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | Karina Drees |
| **Company Name:** | Mojave Air & Space Port |
| **Date Received:** | 4/30/2018 |
| **Response:** | I concur with the final report as written |
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| **Voting Member:** | Jim Armor |
| **Company Name:** | Orbital ATK |
| **Date Received:** | 30 April 2018 |
| **Response:** | Present |

Orbital ATK actively participated in the Streamlined Launch and Reentry Licensing Aviation Rulemaking Committee (ARC). The experience we brought and all issues of concern to Orbital ATK were openly deliberated by the ARC.

The single most important issue to Orbital ATK related to launch from a federal range and we do concur with the ARC's response to this question as previously submitted to the FAA.

However, due to insufficient time for our complete review of responses to other original questions and all of the follow-up questions, Orbital ATK cannot concur at this time on the report, or cannot concur or non-concur on ARC responses to these at this time.

Furthermore, Orbital ATK specifically does not support an ARC report which contains any draft regulatory text, which we believe is outside the boundaries of the ARC process (Appendix E).

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| **Voting Member:** | Christopher Allison |
| **Company Name:** | Sierra Nevada Corp. |
| **Date Received:** | 4/30/2018 |
| **Response:** | I concur with the final report as written, with the following exception |

SNC did not review in detail responses pertaining to hybrid Systems as SNC is not developing a hybrid system. The assumptions was that any ARC input on Hybrid systems were focused on those systems alone and do not necessarily apply to more traditional launch and reentry vehicles.

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| **Voting Member:** | Jim Kuzma |
| **Company Name:** | Space Florida |
| **Date Received:** | 30 April 2018 |
| **Response:** | I concur with the report as written |
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| **Voting Member:** | Caryn Schenewerk |
| **Company Name:** | Space Exploration Technologies, Corp. (“SpaceX”) |
| **Date Received:** | April 30, 2018 |
| **Response:** | SpaceX concurs with the final report as written |
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| **Voting Member:** | Mark Bitterman |
| **Company Name:** | Stratolaunch |
| **Date Received:** | 4/30/2018 |
| **Response:** | Non-concur |

Thank you for including Stratolaunch in the industry ARC. Non-concur does not mean that Stratolaunch disagrees with any of the information in the final report submission. Due to the very compressed timeframe and multiple rounds of changes, Stratolaunch is unable to offer full concurrence, nor full disagreement, with the final report. However, the final report does represent a solid beginning to collaborating on issues likely to be included in the NPRM.

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| **Voting Member:** | Kelly P. Garehime |
| **Company Name:** | United Launch Alliance (ULA) |
| **Date Received:** | 4/30/18 |
| **Response:** | I concur with the report as written with the following exceptions: |

ULA appreciates the opportunity to participate in the Streamlined Launch and Reentry Licensing Aviation Rulemaking Committee (ARC). ULA supports the general direction the FAA is moving to update and streamline launch regulation and ULA looks forward to continued engagement throughout the rulemaking process. ULA generally concurs with the high-level answers that the ARC provided to the FAA's initial questions and follow-up questions. ULA commends industry for working together on such a short timeframe to develop fairly consensus based answers. While ULA believes the high-level responses are generally acceptable, ULA's major concern is how the FAA will implement these comments into new regulation. We strongly encourage the FAA to keep the ARC involved in the process as they craft regulation to avoid misinterpretation of the ARC's comments.

Additionally, ULA does <u>not</u> concur with the inclusion of regulatory redlining and draft text in the ARC's final report. The inclusion of such text in the report suggests that the draft regulatory text was developed as part of the ARC process and had some level of consensus during its formulation. This was not the case. The four companies that separately drafted this language should submit their independent recommendations to the FAA for consideration. The draft language should not be included under the auspices of the ARC process. The language that was submitted has not been vetted through ARC membership and was only provided to ARC members three days before the submission deadline. This proposed regulation draft text does not represent consensus within ARC membership and should not be submitted as part of the ARC final report. ULA notes, however, that it welcomes any future opportunity to be involved in providing draft regulatory language throughout the rulemaking process provided sufficient time is available.

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| **Voting Member:** | Alex Rodriguez |
| **Company Name:** | Vector Launch, Inc. |
| **Date Received:** | 4-29-18 |
| **Response:** | Abstain |
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| **Voting Member:** | Sirisha Bandla |
| **Company Name:** | Virgin Galactic/Virgin Orbit |
| **Date Received:** | April 30, 2018 |
| **Response:** | I concur with the final report as written |

We have not yet had time to review the all redlines provided by the Draft Regulatory Text Task Force. We believe that there should continue to be a channel of communication as AST begins drafting rules for a successful final outcome.

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| **Voting Member:** | Taber MacCallum taber@worldview.space |
| **Company Name:** | World View Enterprises |
| **Date Received:** | 28 April 2018 |
| **Response:** | I concur with the final report as written, with the following exception(s): |

World View supports the proposed submission by industry to FAA with respect to reform of US Commercial Space Launch Licensing with the following caveat.

World View strongly feels that the NEPA review requirement under Module 10. (page 18) should be removed from the licensing of space operations. While this recommendation goes beyond FAA regulations and may be technically outside the charter of this ARC, the issue is part of streamlining launch licenses which the Chair of the National Space Council, Vice President Pence has made clear is a priority. We therefor believe that regulations causing the FAA to become involved in environmental issues should be eliminated and are therefore worthy of comment in this ARC.

Operators must already comply with Federal, State and local environmental regulations, as well as already being subject to each of these agencies enforcement mechanisms. It is therefore costly, time consuming and duplicative to have the FAA involved in determining compliance, or involved in the conduct of an environmental impact study for example. An operator should not even need to demonstrate to the FAA that a given launch operation is in environmental regulatory compliance. Doing so keeps the FAA in the approval loop in an area that it has no real authority, clearly adding burden and in some cases delaying issuance of a license.
The FAA should not be involved in any way with environmental regulations, that is the responsibility of the operator. The operator is already obliged to meet environmental regulations as part of ongoing business operations, just as they meet other Federal, State and local laws and regulations. Having the FAA involved compounds the burden.