Commercial Spaceport Licensing Review and Recommendations White Paper

Commercial Space Transportation Advisory Committee (COMSTAC)
Space Transportations Operations Working Group

October 2012

DRAFT FOR REVIEW

DRAFT
10/8/2012

Executive Summary

In October, 2011, the COMSTAC's Space Transportation Operations Working Group (STOWG) accepted the task of developing a white paper based to provide recommendations for changes to the regulations of 14 CFR Part 420 that would put the regulations into closer alignment with the current industry requirements. The STOWG developed a survey that was made available to a diverse and meaningful cross-section of commercial space industry stakeholders that asked a variety of relevant questions to help assess current views of the spaceport licensing process and provide an opportunity to submit objective, relevant and actionable recommendations for changes.

A total of 33 respondents answered the survey, of whom four (4) identified themselves as "Spaceport Owner", one (1) identified themself as a "Spaceport Owner", "Launch Vehicle Manufacturer" and "Operator", and three (3) identified themselves as "Launch Vehicle Manufactures" and "Operators". Although this group only made up about a quarter of the total responses for the survey, their perspective of the licensing process should hold considerable weight in the discussion on spaceport licensing. This group of respondents consists of the primary stakeholders for spaceport licensing as they are entirely responsible for obtaining and maintaining the commercial launch site license.

The survey responses reflected a consensus that the licensing process, costs and time to complete outlined by current regulations only fit one scenario very well: orbital launch vehicles from dedicated launch ranges. For all other launch vehicles and/or spaceport scenarios, the regulations and licensing process lack the definitions, decision trees and modules to address the relevant dimensions required for each case. Thus, the derived costs and times are less than optimal and reflect over-regulation, under-regulation and/or lack of regulatory accuracy and relevance. The results of the analysis for four "spaceport types" are presented in Figure 1 and highlight several key conclusions. The first conclusion is that the existing regulations are a good "fit" to spaceports modeled after a "Traditional Range." The second conclusion is that the existing regulations are either a moderate "fit" or a poor "fit" for all other spaceport types.

Certification Type	A	B	C	D
Spaceport Type	Traditional Range	Hybrid Range / Aerospaceport	Aerospaceport (Onsite Ignition)	Aerospaceport (Offsite ignition)
14 CFR Part 420 "Fit"	✓	!	!	!
Certification Level	High	Medium	Medium	Low
Launch Trajectory	Vertical	Vertical/Horizontal	Horizontal	Horizontal
Onsite Ignition/Launch	Yes	Yes/No	Yes/No	No
Onsite Recovery	No	No/Yes	Yes	Yes
Onsite Recovery Trajectory	None	None Horizontal Powered Horizontal Unpowered	Horizontal Powered Horizontal Unpowered	Horizontal Powered Horizontal Unpowered
Certification Areas				
Environmental Assessment	✓	✓	✓	!
Explosive Site Plan	✓	✓	✓	!
Flight Corridors	✓	✓	✓	!
Risk Analysis	✓	✓	✓	!
Accident Investigation Plan	✓	!	✓	!
Handling of Propellants	✓	!	!	!
Lightning Protection	✓	!	!	!
Time/Cost	✓	!	!	!
NAS / Airspace Plans	✓	!	!	!
Certification Checklists	✓	!	!	✗

Lengend	
✓	Good "Fit"
!	Moderate "Fit"
✗	Poor "Fit"

Figure 1. Relative "Fit" of Licensing Requirements to Spaceport Types

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In general the survey respondents have indicated that there is currently some misalignment in the one-size-fits-all approach to Part 420. Four potential approaches for addressing the recommendations provided by the survey respondents are provided here.

1) **No Action** – Several respondents were satisfied with the current regulations and recommended that no significant action should be taken to adjust them. The "no action" approach would not make significant modifications to licensing regulations.

2) **Provide Additional Appendix or Published Guidelines** – One approach to clarify the licensing process for a spaceport that will support these types of launch vehicles would be to either amend the current regulations with an additional Appendix that specifically addresses the key requirements of this unique situation, or publish a paper with methodologies and definitions that are applicable to these types of spaceports.

3) **Modify Part 420 to be modular –** Another approach for supporting the licensure of spaceports that may support a wide range of launch vehicle types, or even one specific vehicle type is to provide flexible regulations that can be adjusted easily on a case-by-case basis.

4) **Start Over** – The most extreme approach would involve tossing out most or all of 14 CFR Part 420 and start over with the regulations. The main objective for this approach would be to streamline the regulations as much as possible and eliminate all components which are already covered under different regulations or standards that would apply.

The recommended next steps by are:

1) Discuss observations with COMSTAC STOWG and seek additional input to this report.
2) Review potential methods for re-aligning the regulations with the commercial spaceflight industry, as proposed in section V above. For example, Options 2 and 3 are flexible approaches that would enable the current regulations to stand and create room for additional options as technologies and operating procedures evolve. Option 4 is a more radical approach and may be less palatable to the FAA/AST.
3) Select a recommended approach and submit recommendations to COMSTAC to present to FAA/AST.
4) STOWG form a subcommittee to further flesh out details on the final recommendations, in conjunction with FAA/AST.

In all cases, it is recommended that industry stay closely involved through various industry mechanisms, including STOWG, the Commercial Spaceflight Federation, and the FastForward project, all three of which facilitated participation in the survey.

I. Introduction

As of October 2012, there are currently 8 commercially licensed spaceports/launch sites in the United States. For a commercial spaceport or launch site to obtain a launch site operators license, they must submit an application to the Federal Aviation Administration (FAA) Office of Commercial Space (AST). The regulations that governed the application process (14 CFR Part 420) were developed at a time when most commercial launch operators were focused on orbital launch vehicles that operate from federal launch ranges. Since the regulations were put into effect, the launch vehicle landscape has changed dramatically. This change is most notable since the 2004 private suborbital launches to win the Ansari X PRIZE and the continued development of private orbital launch sites. There has been in increased interest in the development of commercial launch sites and spaceports that are located off federal launch ranges and different launch approaches, such as Horizontal Reusable Launch Vehicles (RLV) or Vertical Takeoff Vertical Landing (VTVL) launch vehicles.

During the October 2011 FAA Commercial Spaceport Transportation Advisory Committee (COMSTAC) working group meetings, the Space Transportation Operations Working Group (STOWG) accepted the task of developing a white paper to provide recommendations for changes to the regulations of 14 CFR Part 420 that would put the regulations into closer alignment with current industry requirements. On behalf of STOWG, a survey on spaceport licensing was developed and sent to spaceports, launch vehicle operators, consultants, and other commercial space stakeholders. The results of the survey have been analyzed and a series of potential "next steps" have been provided based on general respondent feedback.

II. Spaceport Licensing Background

The Commercial Space Launch Act of 1984, as codified at 49 U.S.C. Subtitle IX-Commercial Space Transportation ch. 701-Commercial Space Launch Activities, 49. U.S.C 70101-70121, authorizes the Secretary of Transportation to license a launch or the operation of a launch site carried out by a U.S. citizen or within the United States. On November 15, 1995, the Secretary of Transportation delegated commercial space licensing authority to the Federal Aviation Administration. Since 1988, the Department of Transportation and FAA have taken steps to simplify the licensing process for launch operators, which the largest effort being the completion of 14 CFR Part 420 in October 2000. Since that time, there has not been a significant modification to the regulations, despite a rapidly evolving commercial landscape for launch vehicle operators and launch site operators.

Historically, most commercially licensed launch sites, consisted of fixed / dedicated launch pads that supported vertically launched expendable launch vehicles. The current regulations, provided in 14 CFR Part 420, closely align with the launch site requirements of these types of launch vehicles. While launch sites that support vertically launched expendable launch vehicles are still being developed, there has been a large shift in the development and licensure of other types of commercial launch sites. New commercial launch sites are being developed in both coastal and inland areas and are capable of supporting a wide range of potential launch vehicles, including horizontally launched suborbital RLV's, vertical launch and vertical landing (VTVL) suborbital vehicles, and other launch vehicle systems, both expendable and reusable. Some of the new launch vehicle systems are being developed to require only aviation type facilities, as they can utilize existing airport infrastructure, such as runways and hangars, and standard aviation departure and arrival procedures.

The regulations, as currently written, do not always closely align with the new types of commercial launch systems, as new systems represent a variety of launch and landing approaches, such as operating from runways. Thus, active industry stakeholders have expressed a desire to adjust the regulatory regime of launch site licensing to more closely align with current conditions and enable a more flexible licensing approach.

III. Spaceport Licensing Survey

Before changes to the regulations can be recommended, it is critical to develop an understanding from industry, about how the regulations affect their new commercial launch systems. The COMSTAC Space Transportation Operations Working Group developed a survey that was made available to the commercial space industry stakeholders that asked a variety of questions to help assess current views of the spaceport licensing process and provide an opportunity to submit objective, relevant and actionable recommendations for changes. An online survey was made available from January 18, 2012 through January 30, 2012. A total of 28 participants responded to the survey at this time. The survey was re-opened on July 24, 2012 and remained open until September 19, 2012. Five additional participants provided responses during the second time period. A copy of the specific questions that were asked in survey is provided in Appendix A.

The questions of the survey were structured to provide respondents with an opportunity to describe their role in the commercial space industry, experience related to launch site licensing, and provided feedback on this experience. The primary question areas of the survey were as follows:

1) Identification of organization's role in commercial space activities
2) Identification of prior experience with licensing regulations (14 CFR Part 420)
3) Identification of the types of launch vehicles the respondent has experience with licensing
4) Quantifying the relevance of existing regulations to launch sites that support different launch vehicle types (suborbital/orbital, vertical/horizontal, etc)
5) Identifying schedule drivers
6) Identifying cost drivers
7) General assessment of the relevance of existing regulations to specific respondents
8) Inquiry into experience with license renewal
9) Inquiry into license modification
10) General comments and recommendations

To facilitate the gathering of information related to the topic of spaceport licensing, an attempt was made to ensure that the design of the survey questions were unbiased.

IV. Survey Results and Common Themes

With the help of FAA COMSTAC, the Commercial Spaceflight Federation, and FastForward Project, a link to the online survey was distributed to active members of a wide and relevant cross section of the US commercial space industry. A total of 33 responses were received, nine (9) from existing spaceport owners and/or launch vehicle manufacturers/operators, and 24 from consultants/other relevant stakeholders. While a small sample size, the response was higher than previous COMSTAC STOWG requests and represented a diverse population.

A. Main Theme

The survey responses reflected a consensus that the licensing process, costs and time to complete outlined by current regulations only fit one scenario very well: orbital launch vehicles from dedicated launch ranges. For all other launch vehicles and/or spaceport scenarios, the regulations and licensing process lack the definitions, decision trees and modules to address the relevant dimensions required for each case. Thus, the derived costs and times are less than optimal and reflect over-regulation, under-regulation and/or lack of regulation accuracy and relevance. The data provided in Figure 2 summarizes the responses for ranking the relevance of key launch site licensing requirements to various launch vehicle types. This data is a composite of the responses received from all respondents and demonstrate that, in general, the licensing requirements are perceived as being highly relevant for orbital launch sites and moderately relevant for suborbital launch sites.

All Respondents

	Suborbital			Orbital	
Requirements	Vertical (Expendable)	Vertical (Reusable)	Horizontal	Vertical	Horizontal
Environmental Assessment	✓	✓	✓	✓	✓
Explosive Site Plan	✓	!	✓	✓	✓
Flight Corridor	✓	✓	✓	✓	✓
Risk Analysis	✓	✓	✓	✓	✓
Accident Investigation Plan	!	!	✓	✓	✓
Handling of Propellants	!	!	!	✓	✓
Lightning Protection	!	!	!	✓	✓
Total Responses	8	8	11	3	1

Lengend	
✓	Highly Relevant
!	Moderately Relevant
✗	Not Relevant

Figure 2. Average Relevance of Licensing Requirements from All Respondents

An important result of the survey is that in general there are dramatically different perspectives of the regulations between spaceports/vehicle operators and the views of consultants. Respondents who identified themselves as consultants or "other" generally ranked the relevance of each key requirement of spaceport licensing as being highly relevant. However, for spaceport and launch vehicle operators, many requirements were identified as either being moderately relevant or not relevant at all. A deeper analysis of both perspectives is provided below.

B. Perspective of Spaceports and Launch Vehicle Operators

Of the 33 total respondents, four (4) identified themselves as "Spaceport Owner", one (1) identified themself as a "Spaceport Owner", "Launch Vehicle Manufacturer" and "Operator", and three (3) identified themselves as "Launch Vehicle Manufactures" and "Operators". Although this group only made up about a quarter of the total responses for the survey, their perspective of the licensing process should hold considerable weight in the discussion on spaceport licensing. This group of respondents consists of the primary stakeholders for spaceport licensing as they are entirely responsible for obtaining and maintaining the commercial launch site license.

As shown in Figure 3, this group feels that licensing requirements are more relevant for orbital launch sites than suborbital launch sites. While this reflection mirrors the results for the average of all respondents, this group is considerably more critical of the relevance of the licensing requirements. This group has collectively identified a number of requirements as being "not relevant" to the licensing of a commercial spaceport. These requirements include the accident investigation plan, handling or propellants, and lightning protection. Also of interest is that no licensing requirement was identified as "highly relevant", by this group, for suborbital launch vehicles.

Spaceports & Operators Only

	Suborbital			Orbital	
Requirements	Vertical (Expendable)	Vertical (Reusable)	Horizontal	Vertical	Horizontal
Environmental Assessment	Moderately Relevant	Moderately Relevant	Highly Relevant	Highly Relevant	Highly Relevant
Explosive Site Plan	Moderately Relevant	Moderately Relevant	Moderately Relevant	Highly Relevant	Highly Relevant
Flight Corridor	Moderately Relevant	Moderately Relevant	Highly Relevant	Highly Relevant	Highly Relevant
Risk Analysis	Moderately Relevant	Moderately Relevant	Moderately Relevant	Highly Relevant	Highly Relevant
Accident Investigation Plan	Moderately Relevant	Moderately Relevant	Moderately Relevant	Not Relevant	Highly Relevant
Handling of Propellants	Not Relevant	Not Relevant	Moderately Relevant	Not Relevant	Highly Relevant
Lightning Protection	Not Relevant	Moderately Relevant	Moderately Relevant	Not Relevant	Highly Relevant
Total Responses	4	4	5	1	1

Lengend	
Highly Relevant	
Moderately Relevant	
Not Relevant	

Figure 3. Relevance of Licensing Requirements from Spaceport and Operator Respondents

Some of the general comments/suggestions from spaceports, and launch vehicle manufactures/operators tend to hover around the same general considerations. This group, in general feels that many elements of the launch site license can be handled with existing legal mandates from OSHA, DOT, NFPA, and other bodies and do not require separate regulation. They tend to prefer reducing the regulatory requirements of the spaceport licensing, specifically in cases of suborbital launch sites. This group feels that operational considerations, such as emergency response components, are important components that are not currently required. One launch vehicle manufacturer suggested that the majority of the current 14 CFR Part 420 should be deleted.

C. Perspective of Consultants and Others

A total of 24 respondents identified their role in commercial launch site licensing as either "consultant" or "other". This group consists of individuals with a wide experience base including:

- Consultants with experience preparing license applications and environmental assessments
- Consultants with experience developing regulations or safety requirements
- Advisors to existing and potential spaceports
- Potential spaceports seeking licensure

- Others with experience on policy advocacy
- Other who are attorneys
- Others who are Insurance providers
- Others involved in the training of commercial space activities

It is important to note that not all respondents in this group responded to all questions. Their responses were limited to questions that they felt comfortable in answering. Of the 24 respondents, only 14 of them identified having prior experience with the federal regulations that govern spaceport licensing.

Consultants & Other Only					
	Suborbital			Orbital	
Requirements	Vertical (Expendable)	Vertical (Reusable)	Horizontal	Vertical	Horizontal
Environmental Assessment	✓	✓	✓	✓	
Explosive Site Plan	✓	✓	✓	✓	
Flight Corridor	✓	✓	✓	✓	
Risk Analysis	✓	✓	✓	✓	
Accident Investigation Plan	✓	✓	✓	✓	
Handling of Propellants	✓	!	✓	✓	
Lightning Protection	✓	!	!	✓	
Total Responses	4	4	6	2	0

Lengend	
✓	Highly Relevant
!	Moderately Relevant
✗	Not Relevant

Figure 4. Relevance of Licensing Requirements from Consultants and Other Respondents

The responses of this group reflect a feeling that the current regulations are relevant to the licensing of a commercial spaceport. This perspective is quite a bit different from that of the spaceport operators and launch vehicle manufacturers. The results, as shown in the above table, reflect the general feeling that the current requirements are all important for the safe operation of a commercial spaceport.

While a majority of the consultants indicated that the requirements were highly relevant, a number of the comments and recommendations indicate that this is room for improvement to better align the requirements with specific launch site conditions. In general, responses from representatives from the insurance industry highlight that all requirements "are important issues." Other respondents highlighted that the current regulations "are a better fit for traditional launch vehicles that are launched vertically from a fixed point," and that "if the vehicle is jet powered at the spaceport and ignition elsewhere, the licensing should be constrained to propellant storage and handling issues only." So, while this group indicated understanding the importance of the regulatory requirements, they also indicated that there were cases were the regulations should be tailored more appropriately.

D. Cost and Schedule Analysis

Often, the primary considerations for commercial enterprises are a detailed analysis of both the economics of a proposed action and its schedule. For the commercial spaceflight industry cost and schedule are important factors that are evaluated prior to moving forward. The survey provided survey respondents the opportunity to answer several questions directly related to cost and duration of the spaceport licensing process (including the environmental component).

Of the 13 responses received commenting on the total licensing cost, six respondents provided data. The least expensive licensing was $330,000, the most expensive $3,000,000 and the average expense around $1.3 Million. One respondent noted that licensing was "too costly to pursue", another respondent noted "very" costly, another respondent estimated that their effort will cost between "$1-$2.5M", and another respondent noted that the licensing cost was "a relatively small percentage of the overall spaceport development effort."

Of eight responses to the total spaceport licensing duration, the quickest licensing was completed in about a year, the longest 5 years, and the average was around 2.8 years. One respondent "gave up because of the time and cost

commitment required". In general, a majority of respondents felt that the licensing process was "more costly than expected" and "took longer than expected." Based on the responses to the survey, any adjustments to the licensing process that can enable a reduction in either cost or schedule will be viewed upon positively by spaceport licensing stakeholders.

E. Relative "Fit" of Licensing Requirements to Spaceport Types

By comparing the results of survey to the types of spaceports, it is possible to establish a relative "fit" of the existing licensing requirements to spaceport types. Four groups were created and are defined as follows:

A) Traditional Range – Vertically launched expendable launch vehicles, which are launched from a fixed point. This includes both suborbital and orbital launch vehicles. Examples include SLC-36 and SLC-46 at Cape Canaveral.
B) Hybrid Range / Aerospaceport – A mixed-use launch site which is capable of supporting vertically launched (expendable and reusable) and/or horizontally launched vehicles. The spaceport may include fixed launch sites for Vertical Takeoff Vertical Landing (VTVL) launch vehicles, suborbital expendable launch vehicles, and horizontal reusable launch vehicles. Examples include Mojave Air and Space Port and Spaceport America.
C) Aerospaceport (Onsite Ignition) – A spaceport that can support horizontal reusable launch vehicles that ignite their rocket engines and begin their suborbital/orbital flight profile from the spaceport property. These Aerospaceports consist almost entirely of aviation-type facilities and may exist on a new or existing airport.
D) Aerospaceport (Offsite Ignition) – A spaceport that can support horizontal reusable launch vehicles that ignite their rocket engines away from a spaceport. These Aerospaceports consist almost entirely of aviation-type facilities and may exist on an existing or new airport. An example is Cecil Spaceport.

Certification Type	A	B	C	D
Spaceport Type	Traditional Range	Hybrid Range / Aerospaceport	Aerospaceport (Onsite Ignition)	Aerospaceport (Offsite ignition)
14 CFR Part 420 "Fit"	✓	!	!	!
Certification Level	High	Medium	Medium	Low
Launch Trajectory	Vertical	Vertical/Horizontal	Horizontal	Horizontal
Onsite Ignition/Launch	Yes	Yes/No	Yes/No	No
Onsite Recovery	No	No/Yes	Yes	Yes
Onsite Recovery Trajectory	None	None Horizontal Powered Horizontal Unpowered	Horizontal Powered Horizontal Unpowered	Horizontal Powered Horizontal Unpowered
Certification Areas				
Environmental Assessment	✓	✓	✓	!
Explosive Site Plan	✓	✓	✓	!
Flight Corridors	✓	✓	✓	!
Risk Analysis	✓	✓	✓	!
Accident Investigation Plan	✓	!	✓	!
Handling of Propellants	✓	!	!	!
Lightning Protection	✓	!	!	!
Time/Cost	✓	!	!	!
NAS / Airspace Plans	✓	!	!	!
Certification Checklists	✓	!	!	✗

Lengend	
✓	Good "Fit"
!	Moderate "Fit"
✗	Poor "Fit"

Figure 5. Relative "Fit" of Licensing Requirements to Spaceport Types

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10/8/2012

The results of the analysis for the four "spaceport types" are presented in Figure 4 and highlight several key conclusions. The first conclusion is that the existing regulations are highly relevant to spaceports modeled after a "Traditional Range." The second conclusion is that the existing regulations are either moderately relevant or not relevant for all other spaceport types.

V. Discussion of Recommendations Provided by Respondents

Based on the results of the survey and recommendations provided by the respondents a number of common themes have been identified. The following discussion has been provided to identify a few areas were adjustment to the regulations should be focused. Additionally several potential approaches for re-aligning the regulations have been provided to further the discussion on the spaceport licensing process.

A. Alignment of FAA Explosive Siting / Handling Requirements with Other Industry Standards

In the recent FAA Notice of Proposed Rule Making (NPRM) dated February 16, 2011, an attempt was demonstrated for adjusting the regulations that govern explosive siting requirements. Some proposed changes, such as eliminating the separation distances for some stored propellants are reflective of loosening requirements. Unfortunately, other proposed changes, such as the introduction of the "public in the open" distance can be challenges for some proposed and existing spaceports. The proposed regulations provide some additional guidance and alignment with the current DoD explosive safety manual, however there are still existing holes in the proposed regulations, where certain propellants combinations are addressed, yet other common commercial propellant combinations are missing entirely (such as Nitrous Oxide and HTPB). There is general consensus among the survey respondents and the commercial spaceflight industry that propellant handling regulations be removed completely and applicable industry standards be used instead. For a spaceport that is being developed on an existing airport, there is a desire to have suborbital reusable launch vehicle operations mirror the aviation operational approach.

B. Alignment of Air Space Coordination

Existing regulations require that agreements be made with the U.S. Coast Guard and FAA Air Traffic Control office having jurisdiction over the airspace through which launches take place. While these agreements identify the procedures for issuance of a Notice to Mariners and Notice to Airmen respectively there is further need to streamline the process. One recommendation is to require spaceports to develop procedures for cooperative use of airspace. An airspace coordination plan should be developed in cooperation with existing airspace stakeholders and authorities and include a mechanism for filing flight plans and for identifying affected airspace authorities of flights in a timely manner. The regulation should be limited to only identifying the required elements of the plan and should not specify the specific procedures. It is also critical that appropriate separation criteria be established between launch vehicles and non-participating aircraft. Historical launch protections involve large areas of airspace subject to temporary flight restrictions. This does not seem to be a workable model as the number of flight locations and frequency of launches increase.

C. Alignment of Emergency Response Needs

While an "accident investigation plan" is currently required by regulation, an "emergency response plan" is not. The spaceport should be required to have emergency response services and an emergency response plan. This plan should include procedures for spacecraft accidents, hazardous spills, injuries and fires. Relevant authorities and responders should be identified and a mechanism put in place to notify them in an emergency. If there are special hazards associated with the launch vehicle that will operate from the spaceport, first responders need to be notified of the specifics in advance, such as chemicals used, so respondents can be prepared in an emergency. In addition, there should be a documented plan for how injured persons will get medical services. The regulation should be limited to only identifying the required elements of the plan and should not specify the specific procedures.

D. Other Recommendations

Some other recommendations that should be considered for discussion are:

- Explore the possibility of certifying Designated Engineering Representatives (DER) for relevant and appropriate certification of spaceports, which is currently performed by FAA/AST engineers.
- Requirements for a lightning advisory system/method
- Provide a checklist-like approach for the launch site application
- Provide flexibility to the regulations to ease licensing of a wide range of launch vehicle and spaceport types

E. Potential Approaches to Re-aligning the Regulations

In general the survey respondents have indicated that there is currently some misalignment by the one-size-fits-all approach to Part 420. Three potential approaches for addressing the recommendations provided the survey respondents are provided here. A complete listing of comments and other potential recommendations are provided in Appendix B.

1) No Action – Several respondents were satisfied with the current regulations and recommended that no significant action should be taken to adjust them. The "no action" approach would not make significant modifications to licensing regulations.

2) Provide Additional Appendix or Published Guidelines – There are several cases where the current regulations do not cleanly align with the current direction that the commercial spaceflight industry has headed. The most vivid example is the licensing of a spaceport to support horizontally reusable launch vehicles. The current regulations do not provide clear definition of a launch point for a launch vehicle that operates in an aviation mode during a large portion of its mission. Additionally, the guidelines for the development of a flight corridor do not clearly define how to develop a flight corridor for horizontal reusable launch vehicles. One approach to clarify the licensing process for a spaceport that will support these types of launch vehicles would be to either amend the current regulations with an additional Appendix that specifically addresses the key requirements of this unique situation, or publish a paper with methodologies and definitions that are applicable to these types of spaceports.

3) Modify Part 420 to be modular – Another approach for supporting the licensure of spaceports that may support a wide range of launch vehicle types, or even one specific vehicle type would be to provide flexible regulations that can be adjusted easily on a case-by-case basis. For an orbital launch site, most of the current regulations are directly applicable. For a low altitude vertical takeoff vertical landing test site, most of the current regulations are excessive. If Part 420 was adjusted to be modular with a matrix that identifies the level of detail of key requirements relative only to specific launch vehicle types, then a spaceport could apply for a license by addressing only the requirements that were applicable to their situation.

4) Start Over – The most extreme approach would involve tossing out most or all of 14 CFR Part 420 and starting over with the regulations. The main objective for this approach would be to streamline the regulations as much as possible and eliminate all components which are already covered under different regulations or standards that would apply. An example approach was provided by a survey respondent and is provided in Appendix C.

VI. Recommended Next Steps

The survey responses provide new perspectives to the spaceport licensing process and indicate that a one size fits all approach is a mismatch with current and planned space transportation approaches, particularly for horizontal reusable launch vehicles operating from runways. This paper gives a guideline to options that the FAA/AST could pursue with respect to this particular case.

The recommended next steps are:

1) Discuss observations with COMSTAC STOWG and seek additional input to this report.
2) Review potential methods for re-aligning the regulations with the commercial spaceflight industry, as proposed in section V above. For example, Options 1 and 2 are flexible approaches that would enable the current regulations to stand and create room for additional options as technologies and operating procedures evolve. Option 3 is a more radical approach and may be less palatable to the FAA/AST.
3) Select a recommended approach and submit recommendations to COMSTAC to present to FAA/AST.
4) STOWG form a subcommittee to further flesh out details on the final recommendations, in conjunction with FAA/AST.

In all cases, it is recommended that industry stay closely involved through various industry mechanisms, including STOWG, the Commercial Spaceflight Federation, and the FastForward project, all three of which facilitated participation in the survey. It is critical that FAA/AST initiate early dialog among all stakeholders prior to entering the rulemaking process to enable a better understanding of requirements that will have a direct impact on the commercial spaceflight industry. The regulations need to be flexible to allow for variation to support different types of launch systems and spaceport.

VII. Authors

The following members of the COMSTAC Space Transportation Operations Working Group contributed to the development of this white paper. The views presented are from the authors and not necessarily that of their organizations.

Brian Gulliver, PE – Spaceport Planning Specialist, Reynolds, Smith and Hills, Inc. 2235 N. Courtenay Parkway, Suite C, Merritt Island, FL 32953. brian.gulliver@rsandh.com

Oscar Garcia – Chairman, InterFlight Global Corporation, Miami Center, 201 S. Biscayne Blvd, 28th Floor, Miami, FL 33131. oscargarcia@interflightglobal.com

Debra Facktor Lepore – Chair of COMSTAC STOWG; President, DFL Space LLC; and Industry Professor, Stevens Institute of Technology, Hoboken, NJ. Debra.Lepore@stevens.edu

Jeff Greason – President, XCOR Aerospace, PO Box 1163, Mojave, CA 93502. jgreason@xcor.com

VIII. Acknowledgments

The authors would like to thank Reynolds, Smith and Hills, Inc., InterFlight Global Corporation, DFL Space, and XCOR Aerospace for providing research funding, computer time and other technical resources for accomplishing this work. The authors would also like to thank the Commercial Spaceflight Federation and FastForward Project for helping to notify their spaceport and launch vehicle members of the spaceport licensing survey. The authors also appreciate the input from all of those who took the time to respond to the survey.

Appendix A – STOWG Spaceport Licensing Survey

January 9, 2012

Commercial Launch Site Licensing Optimization Survey

The Space Transportation Operations Working Group of the Commercial Space Transportation Advisory Committee (COMSTAC) is currently in the process of developing a white paper on the topic of FAA/AST spaceport licensing process optimization. The goal is to gather actionable suggestions , feedback, and supporting rationale from commercial spaceports, launch sites, launch vehicle operators, and others organizations with experience obtaining or intending to obtain a license to operate a commercial launch site (14 CFR Part 420). The data collected via this survey will be used to provide feedback and suggestions to the FAA on which aspects of the licensing process are viewed as valuable and efficient and which aspects can be improved upon.

Please fill out this survey as completely as possible. If you have additional comments on the topic of 14 CFR Part 420, please provide those as well. Name and details are optional.

Please email completed survey to Brian Gulliver (brian.gulliver@rsandh.com) by January 31, 2012.

Name:

Organization:

Contact Information:

January 9, 2012

1. Please identify your organization's role in Commercial Space activities (check all that apply).

( ) Spaceport / Launch Site Owner
( ) Launch Vehicle Manufacturer
( ) Launch Vehicle Operator
( ) Consultant
( ) Other (please specify):

2. Do you have prior experience with the federal regulations governing the launch site licensing process (14 CFR Part 420)?

( ) Yes
( ) No

2a. If yes, what role were you involved in?

2b. If no, but intending to in the future, what role will you be involved in?

3. What types of space launch vehicles have you been involved with licensing a commercial spaceport for? (check all that apply)

[ ] Suborbital Vertical Launch (Expendable)
[ ] Suborbital Vertical Launch (Reusable) includes VTVL
[ ] Suborbital Horizontal Launch [ ] Ignition at site [ ] Ignition away from site
[ ] Orbital Vertical Launch
[ ]) Orbital Horizontal Launch [ ] Ignition at site [ ] Ignition away from site

Additional Comment (Optional):

DRAFT 10/8/2012

January 9, 2012

4.) For each of the types of space launch vehicles you identified in Question 3, please rate how relevant each launch site licensing requirement is to that specific case. (1 is least relevant and 5 is most relevant)

Suborbital Vertical Launch (Expendable)

	least				most
Environmental Assessment	(1)	(2)	(3)	(4)	(5)
Explosive Site Plan	(1)	(2)	(3)	(4)	(5)
Development of a Flight Corridor	(1)	(2)	(3)	(4)	(5)
Risk Analysis of Flight Corridor	(1)	(2)	(3)	(4)	(5)
Launch Site Accident Investigation Plan	(1)	(2)	(3)	(4)	(5)
Handling of Propellants	(1)	(2)	(3)	(4)	(5)
Lightning Protection	(1)	(2)	(3)	(4)	(5)

Additional Comment (Optional):

Suborbital Vertical Launch (Reusable) includes VTVL

	least				most
Environmental Assessment	(1)	(2)	(3)	(4)	(5)
Explosive Site Plan	(1)	(2)	(3)	(4)	(5)
Development of a Flight Corridor	(1)	(2)	(3)	(4)	(5)
Risk Analysis of Flight Corridor	(1)	(2)	(3)	(4)	(5)
Launch Site Accident Investigation Plan	(1)	(2)	(3)	(4)	(5)
Handling of Propellants	(1)	(2)	(3)	(4)	(5)
Lightning Protection	(1)	(2)	(3)	(4)	(5)

Additional Comment (Optional):

January 9, 2012

Suborbital Horizontal Launch

	least				most
Environmental Assessment	(1)	(2)	(3)	(4)	(5)
Explosive Site Plan	(1)	(2)	(3)	(4)	(5)
Development of a Flight Corridor	(1)	(2)	(3)	(4)	(5)
Risk Analysis of Flight Corridor	(1)	(2)	(3)	(4)	(5)
Launch Site Accident Investigation Plan	(1)	(2)	(3)	(4)	(5)
Handling of Propellants	(1)	(2)	(3)	(4)	(5)
Lightning Protection	(1)	(2)	(3)	(4)	(5)

Additional Comment (Optional):

Orbital Vertical Launch

	least				most
Environmental Assessment	(1)	(2)	(3)	(4)	(5)
Explosive Site Plan	(1)	(2)	(3)	(4)	(5)
Development of a Flight Corridor	(1)	(2)	(3)	(4)	(5)
Risk Analysis of Flight Corridor	(1)	(2)	(3)	(4)	(5)
Launch Site Accident Investigation Plan	(1)	(2)	(3)	(4)	(5)
Handling of Propellants	(1)	(2)	(3)	(4)	(5)
Lightning Protection	(1)	(2)	(3)	(4)	(5)

Additional Comment (Optional):

January 9, 2012

Orbital Horizontal Launch					
	least				most
Environmental Assessment	(1)	(2)	(3)	(4)	(5)
Explosive Site Plan	(1)	(2)	(3)	(4)	(5)
Development of a Flight Corridor	(1)	(2)	(3)	(4)	(5)
Risk Analysis of Flight Corridor	(1)	(2)	(3)	(4)	(5)
Launch Site Accident Investigation Plan	(1)	(2)	(3)	(4)	(5)
Handling of Propellants	(1)	(2)	(3)	(4)	(5)
Lightning Protection	(1)	(2)	(3)	(4)	(5)

Additional Comment (Optional):

5. Do you feel that the licensing process (including environmental assessment):

( ) Took less time than I expected

( ) Took as long as I expected

( ) Took longer than I expected

5a) How long did the whole process take?

5b) What were some of the key factors that affected the duration of the process?

Additional Comment (Optional):

6. Do you feel that the licensing process (including environmental assessment):

( ) More economical than I expected

( ) As economical as I expected

( ) Less economical than I expected

5a) How costly was the licensing process?

5b) What were the primary cost drivers?

Additional Comment (Optional):

7. Do you feel that the licensing process, as is, was relevant to your situation?

( ) Yes

( ) No

( ) Somewhat

7a. Please explain what specifically was/was not relevant (ie: scope, time, cost or others):

7b. What are some actionable improvements to the regulations that would help to make them more relevant in your case?

8. Have you been involved in renewing an existing license?

( ) Yes

( ) No

8a. If Yes, please provide additional comments about the process and any recommendations for improving it.

9. Have you been involved in the process to modify an existing license?

( ) Yes

( ) No

9a. If Yes, please provide additional comments about the process and any recommendations for improving it.

10. Please provide any additional comments and recommendations regarding the licensing process that be used by the FAA to help improve the process and make it more relevant to your situation.

Appendix B – Comments / Recommendations by Survey Respondents

The following comments are provided based on the survey responses that were received. Names and organizations have been withheld.

A. Respondents Organizations Role

A total of 33 respondents provided feedback by filling out the survey. Of the 33 respondents:

- Four (4) identified themselves as "Spaceport Owner"
- One (1) identified themself as a "Spaceport Owner", "Launch Vehicle Manufacturer" and "Operator"
- Three (3) identified themselves as "Launch Vehicle Manufactures" and "Operators"
- One (1) identified themselves as "Launch Vehicle Operator"
- Seven (7) identified themselves as "Consultants"
- Three (3) identified themselves as "Consultants" and "Other"
- Ten (14) identified themselves as "Other"

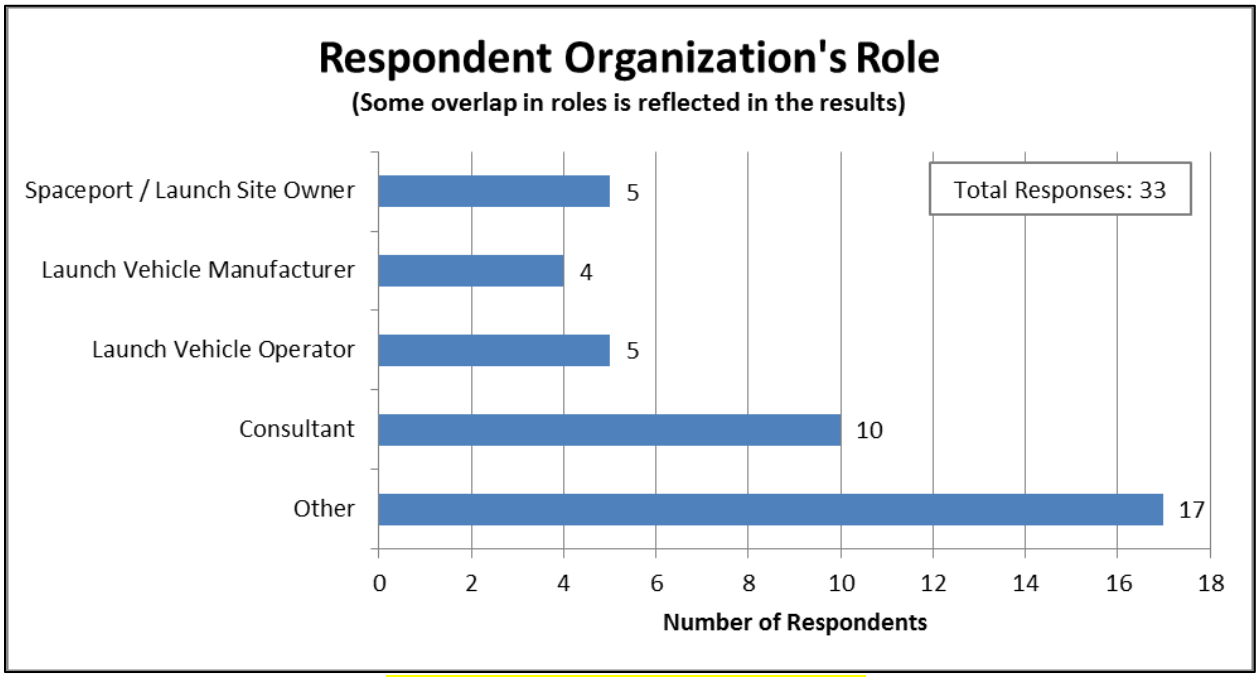

Figure 6. Respondent Organization's Role

The following responses were provided to describe "Other" role:

Affiliation	Specifics on "Other"
Other	Advisors and auditors to investors, economic, business and financial developers of the commercial space economy in the USa and worldwide
Other	Policy advocacy, education and training, research and development with FAA AST.
Other	Insurance provider
Other	Federal Regulator
Other	Advocate
Other	We are developing a training company that will train flight and ground crews for the commercial human spaceflight industry.
Other	Amdinistrative Lead, FAA COE CST PI FAA Task under CIE "Develop a Framework for Spaceport Operations to Capture the Body of Knowledge for Best Practices through 2012."
Other	Beginning the spaceport licensing process
Other	Attorney
Other	Develop procedures for FAA in regard to commercial space activities in the NAS.

Other	OPR for AFSPC 91-7XX series publications (launch/range safety requirements). Establish range safety requirements for the users of AFSPC ranges.
Other	Aerospace insurance company
Other	Manufacturer of Space Vehicles
Other	Academic, writing doctoral thesis on spaceport regulations
Other	Insurance provider – launch liability, in-orbit liability, products liability, etc.
Other	Environmental Engineer supporting Space and Missile Systems Center

B. Respondents Experience with 14 CFR Part 420

Of the 33 total respondents, 21 identified themselves as having "prior experience with the federal regulations governing the launch site licensing process (14 CFR Part 420)." When asked about specific areas of experience, the respondents further refined their response to the following categories:

- Eleven (11) respondents had prior experience with vertically launched expendable suborbital launch vehicles.
- Ten (10) respondents had prior experience with vertically launched reusable suborbital launch vehicles.
- Thirteen (13) respondents had prior experience with horizontally launched suborbital launch vehicles.
- Seven (7) respondents had prior experience with vertically launched orbital launch vehicles.
- Three (3) respondents had prior experience with horizontally launched orbital launch vehicles.

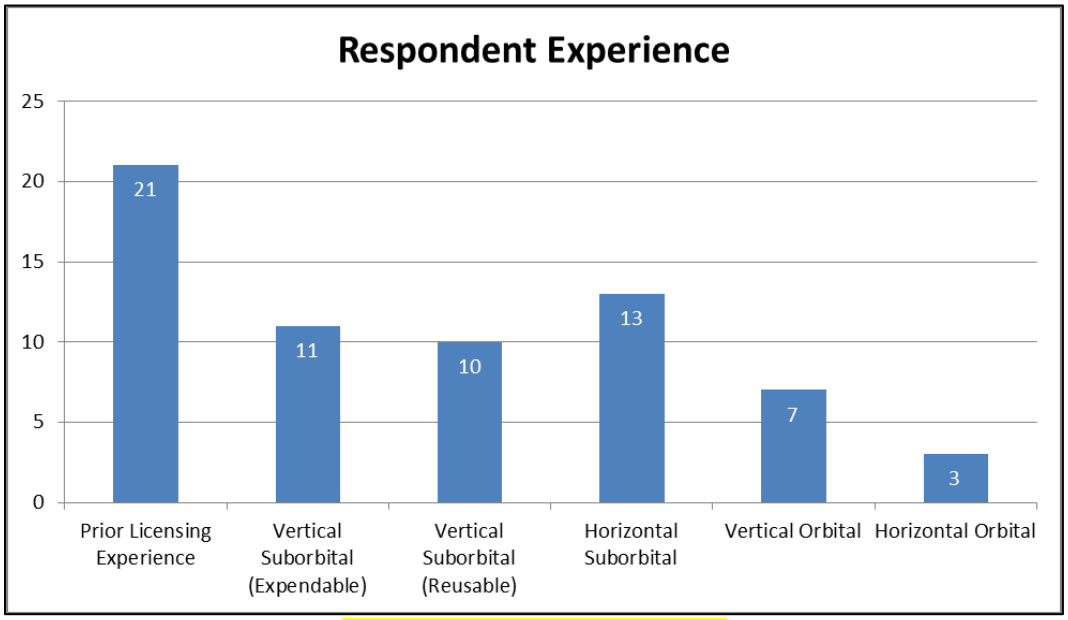

Figure 7. Respondent Experience

C. Vertically Launched Suborbital Expendable Launch Vehicles

The ratings of the relevance of vertically launched suborbital expendable launch vehicles (like sounding rockets) indicate that spaceports and launch vehicle manufacturers feel that the propellant handling and lightning protection requirements do not closely fit these launch vehicles.

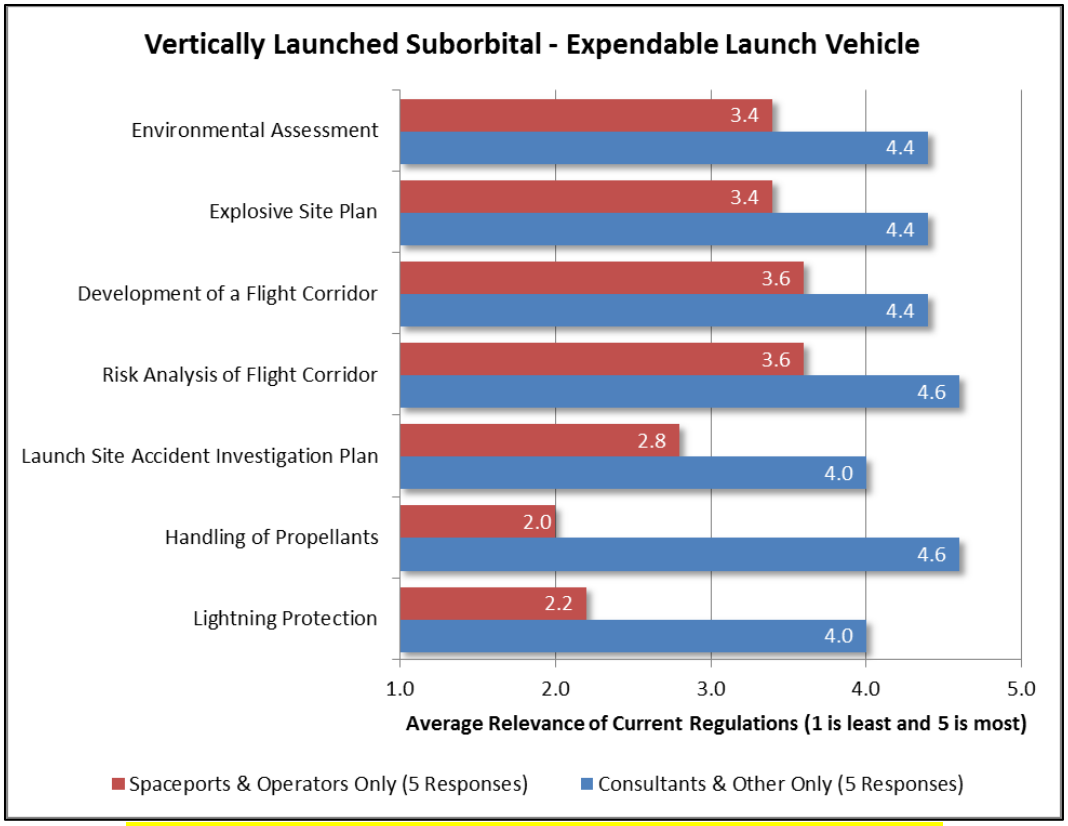

Figure 8. Vertically Launched Suborbital – Expendable Launch Vehicle

A summary of the additional comments is provided in the following table:

Affiliation	Additional Comments
Launch Vehicle Manufacture / Operator	"Many elements of the launch site license can be handled with existing legal mandates from OSHA, NFPA and other bodies and do not require separate legislation especially if they are more onerous. The environmental assessment is a reasonable but the EPA has taken extreme positions on almost every aspect of business. There should also be some decision that are blatantly obvious and not require expensive and lengthy analysis ... if one can accept a Delta or Atlas launch from an environmental standpoint at a given location, an environmental assessment should not be required for a small RLV."
Launch Vehicle Manufacture / Operator	"The insurance people will want the propellant and lightning stuff. plus its all vehicle dependent, you need to focus on a flight corridor and a EA"
Consultant	"The development of a safe launch flight corridor showed that there was at least one path that a vehicle could fly from the proposed spaceport. That was considered sufficient, after the spaceport met all the other requirements, to allow the FAA to issue a license even if the vehicle was not yet built. A second flight corridor (which may be the actual flight path) could deviate from the license, may then require a license modification (with a further environmental and safety analyses) before the license would be amended for the second flight path. The Spaceport should have an accident investigation plan, as the spaceport personnel may be called upon by local authorities to be part of a first responder's team. However, there may well be additional

	independent accident investigations carried out by a State authority or the NTSB and the Spaceport accident plan should be prepared to support these investigations. Lightning protection may be a safety issue at specific spaceports launching certain vehicles and should be considered on an individual basis. Potential lightning strikes that are not mitigated through lightning protection, may limit the operation of the spaceport's launch site."
Other: Insurance	"All are important issues"

D. Vertically Launched Suborbital Reusable Launch Vehicles

The ratings of the relevance of vertically launched suborbital reusable launch vehicles (like vertical takeoff and vertical landing vehicles) indicate that spaceports and launch vehicle manufacturers feel that the propellant handling requirements do not closely fit these launch vehicles.

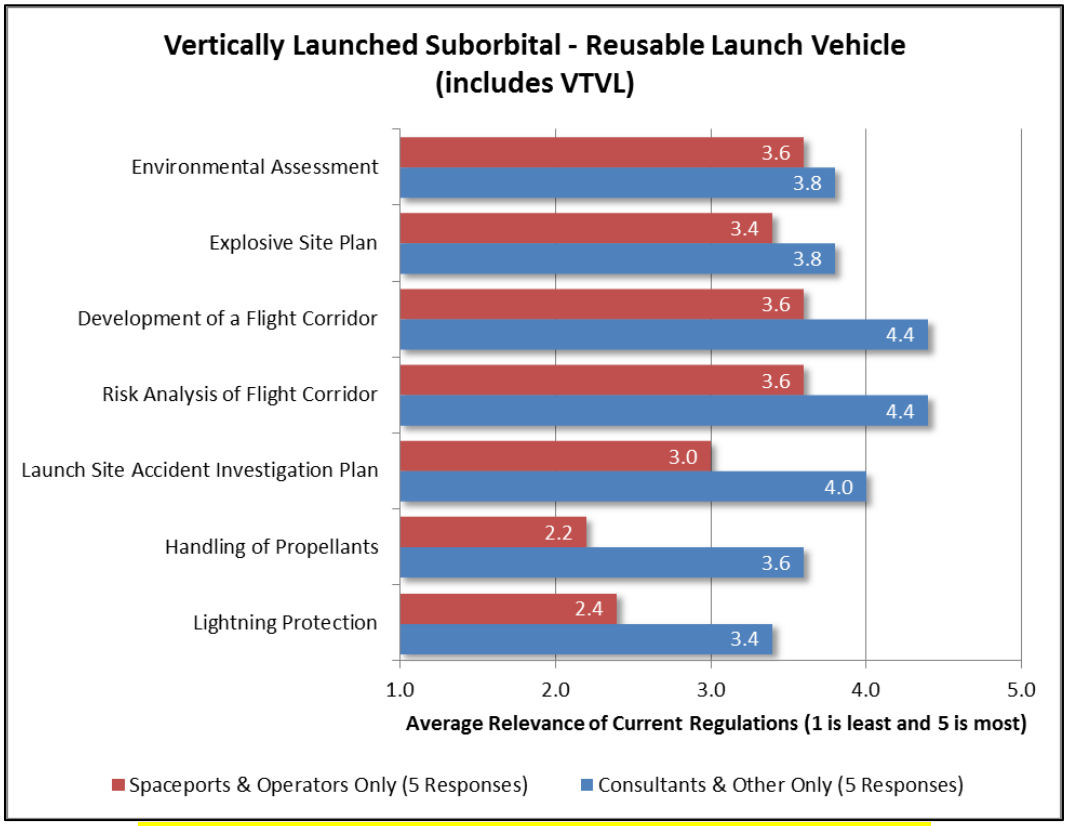

Figure 9. Vertically Launched Suborbital – Reusable Launch Vehicle

A summary of the additional comments is provided in the following table:

Affiliation	Additional Comments
Launch Vehicle Manufacture / Operator	"Many elements of the launch site license can be handled with existing legal mandates from OSHA, NFPA and other bodies and do not require separate legislation especially if they are more onerous. The environmental assessment is a reasonable but the EPA has taken extreme positions on almost every aspect of business. There should also be some decision that are blatantly obvious and not require expensive and lengthy analysis ... if one can accept a Delta or Atlas launch from an environmental standpoint at a given location, an environmental assessment should not be required for a small RLV."
Other: Insurance	"All are important issues"

E. Horizontally Launched Suborbital Launch Vehicles

A total of 13 respondents provided ratings for the relevance of the horizontally launched suborbital launch vehicles. Current generation reusable launch vehicles, like Virgin Galactic's SpaceShipTwo and XCOR's Lynx fit into this category. The results of the rating indicate that spaceport and launch vehicle operators tend to feel that the current regulations are moderately relevant to these types of launch vehicles.

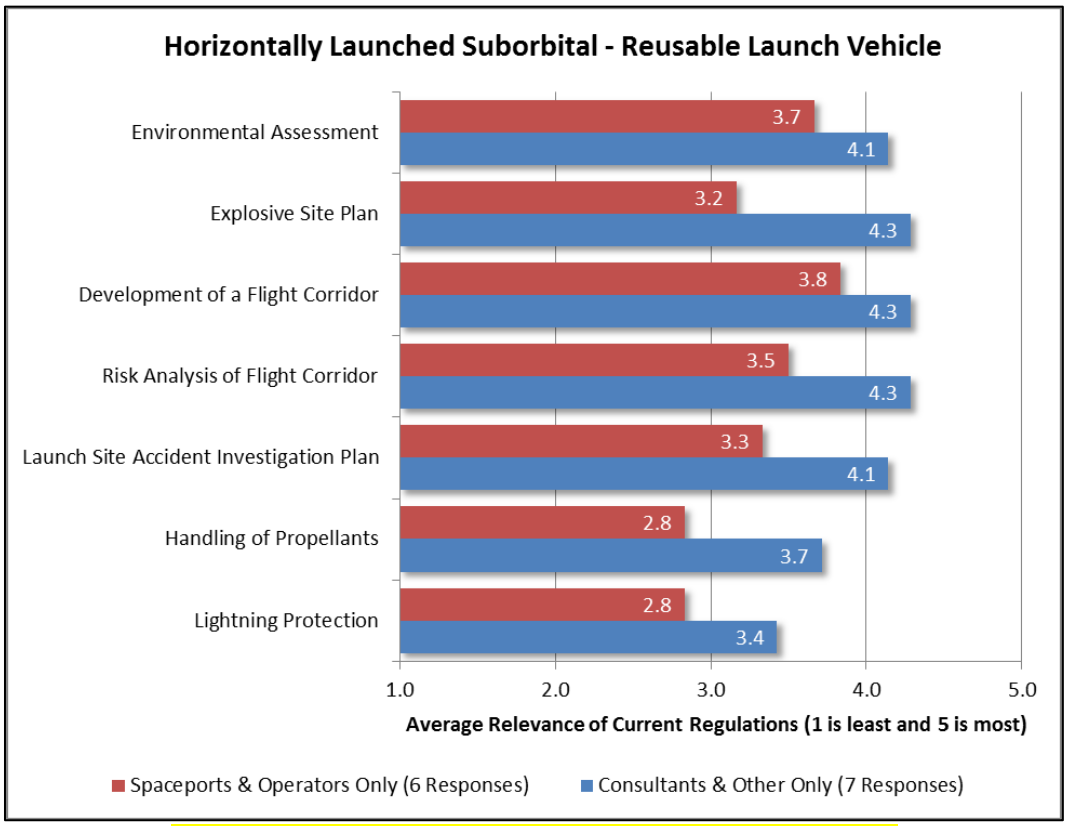

Figure 10. Horizontally Launched Suborbital – Launch Vehicle

A summary of the additional comments is provided in the following table:

Affiliation	Additional Comments
Spaceport	"seems there should be an emergency response component"
Launch Vehicle Manufacture / Operator	"Our vehicles take-off and land conventionally under jet engine power. Rocket powered flight commences at altitude, not necessarily within the operational boundaries of the spaceport. Further, our hybrid propellants are considered non-explosive and therefore do not require the type of handing, storage and operational safety requirements as those required for either solid or liquid propellant systems."
Consultant	"I felt that the regulations, as written, are a better fit for traditional launch vehicles that are launched vertically from a fixed point. It seemed that we were trying to force-fit the operations of a horizontally launched RLVs into regulations designed for vertically launched ELVs."
Consultant	"Licensing requirement for jet powered horizontally launched vehicles with ignition points away from the spaceport needs a sub chapter to simplify the process. Certification process for the ground should be limited to handling, storage and loading-transporting propellants other than conventional jet engine Kerosene."
Other: Insurance	"All are important issues"

F. Vertically Launched Orbital Launch Vehicles

The sample size for the responses for "Vertically Launched Orbital Launch Vehicles" was fairly small and consisted of a spaceport, a consultant, and a representative from the insurance industry. Similar to the ratings of the relevance of the regulations for suborbital launch vehicles, there was a difference in perspective between launch site operators and consultants.

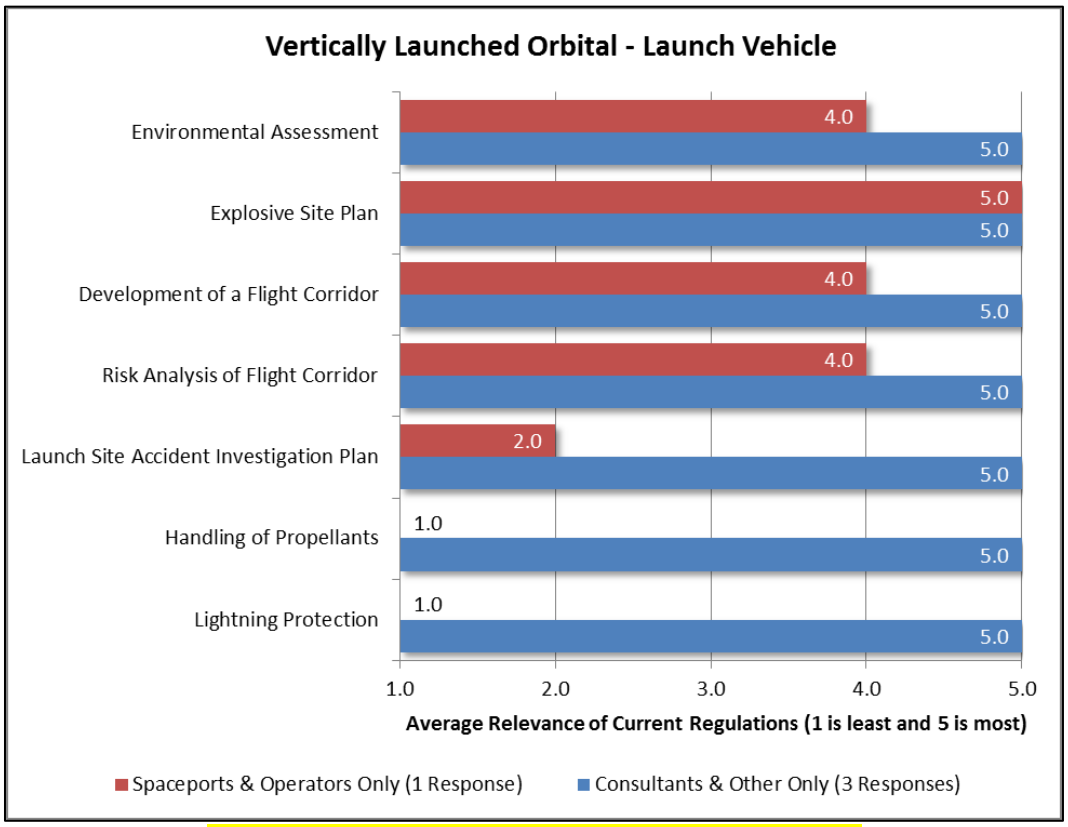

Figure 11. Vertically Launched - Orbital Launch Vehicle

A summary of the additional comments is provided in the following table:

Affiliation	Additional Comments
Other: Insurance	"All are important issues"

G. Horizontally Launched Orbital Launch Vehicles

Only one response was received providing rankings for the relevance of the licensing regulations for a horizontally launched orbital launch vehicle. While presently there is no commercial spaceport licensed to support a horizontally launched orbital launch vehicle, the recent announcement of the development of the "Stratolaunch" system indicates that licensing considerations for this type of launch vehicle will need to be addressed in the near future. No additional comments were provided.

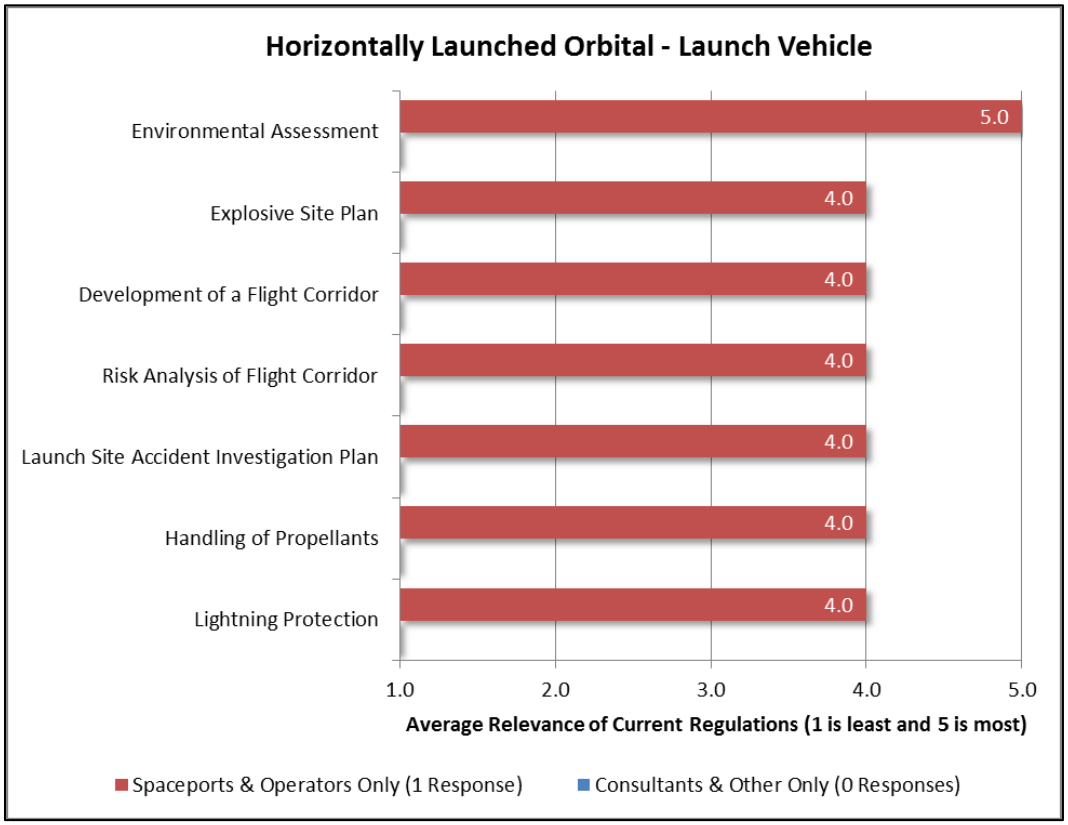

Figure 12. Horizontally Launched - Orbital Launch Vehicle

H. Primary Schedule Drivers

The following figure and table provide a summary of the responses related to questions on the overall duration of the spaceport licensing process. Of eight responses to the total duration, the quickest licensing was completed in about a year, the longest 5 years, and the average was around 2.8 years. One respondent "gave up because of the time and cost commitment required".

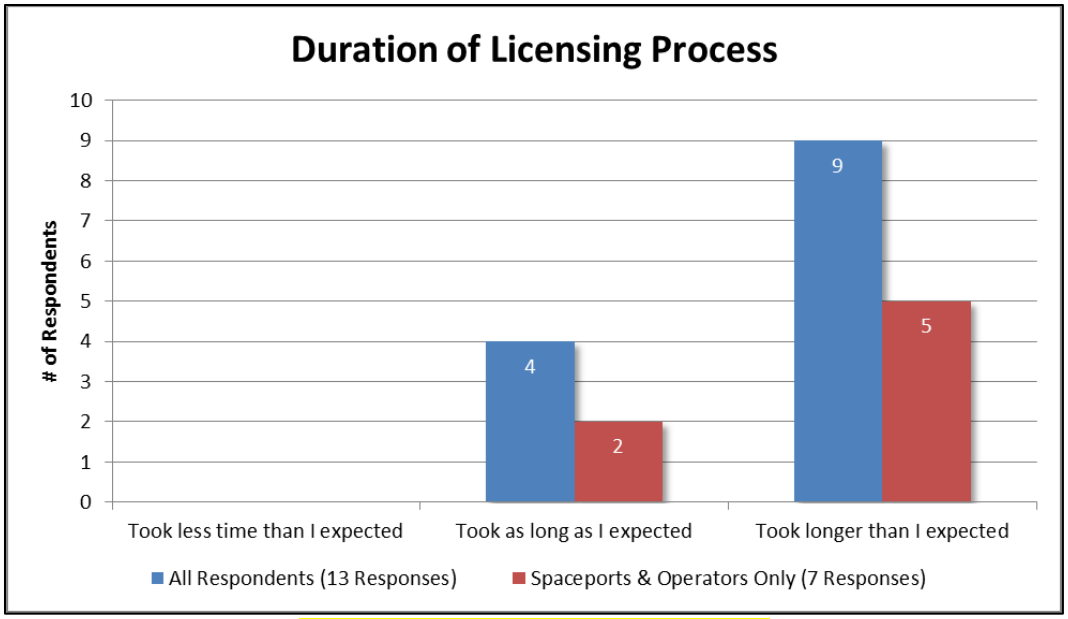

Figure 13. Duration of Licensing Process

Affiliation	Primary Schedule Driver
Spaceport	"The flight of Space Ship One on 21 June 2004"
Spaceport	"Lack of legal clarity, Flip Flop on qualification of contractor to do EIS"
Spaceport	"Generating required data for FAA analysis; generating environmental assessments and reports"
Spaceport	"Environmental and Air Space Investigation"
Launch Vehicle Manufacture / Operator	"Environmental issues"
Launch Vehicle Manufacture / Operator	"The FAA's absurd and duplicative explosive handling standards Lack of a suitable CATEX for spacecraft ground handling leading to EA issues absurd by aircraft practice"
Launch Vehicle Manufacture / Operator	"corridor risk assessment"
Consultant	"Flight corridor development, coordination will all stakeholders, learning curve, environmental assessment."
Consultant	"Characteristics of the vehicles to be launched. Availability of restricted airspace. Ability to develop a flight corridor with acceptable risk characteristics. The FAA calculation methodology as specified vs. as actually performed."
Other	"In our case, we had to raise the funds from the state and other entities, get people skilled up to do the work, and then we discovered, the first EIS had to be discarded because it was led by…a state entity. It had to be re-bid, re-done and re-submitted. The people who worked it are much better able to provide details, I was on the outside as a consumer waiting for this process to move forward. There are many steps to take before a spaceport gets licensed, and of course, a license does not ensure survivability as a spaceport. It's a necessary initial set of steps. Yet, it is also a ticket into a very exclusive club. Eight licensed space ports is very slow growth for an industry."
Other	"Environmental Impact Analysis in stratosphere"

I. Primary Cost Drivers

The following figure and table provide a summary of the responses related to questions on the overall cost of the spaceport licensing process. Of the 11 responses to the total licensing cost only four respondents provided licensing costs. The least expensive licensing was $330,000, the most expensive $3,000,000 and the average expense around $1.3 Million. One respondent noted that licensing was "too costly to pursue", another respondent noted "very" costly, another respondent estimated that their effort will cost between "$1-$2.5M", and another respondent noted that the licensing cost was "a relatively small percentage of the overall spaceport development effort."

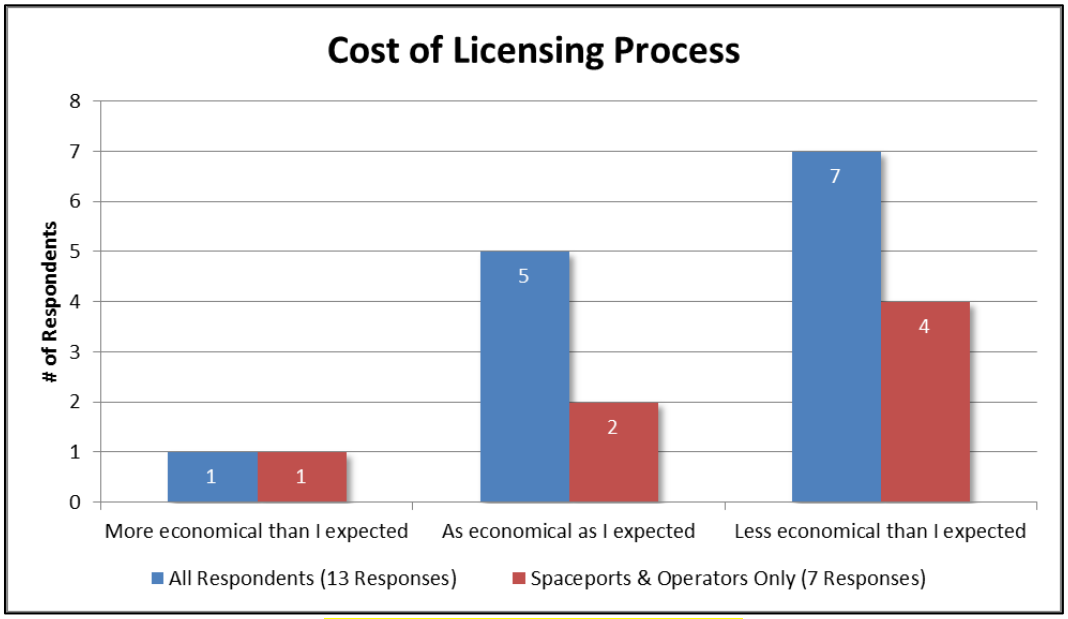

Figure 14. Cost of Licensing Process

The following table provides a summary of the responses related to the comments about the primary cost driver for the spaceport licensing process:

Affiliation	Primary Cost Driver
Spaceport	"Time"
Spaceport	"EIS"
Spaceport	"Detailed investigations that were required for all aspects related to the licensing process"
Launch Vehicle Manufacture / Operator	"Environmental"
Launch Vehicle Manufacture / Operator	"Too many consultants, poor management"
Consultant	"Environmental Assessment, total duration of application process, flight corridor and risk analysis."
Consultant	"1 Environmental study 2 Flight corridors 3 Propellant management plans 4 Commercial and economic feasibility 5 Civic, social and political lobbying 6 Legal and financial issues"
Other	"personnel costs"

J. License Renewal

The following table provides a summary of the responses related to comments or recommendations on the license renewal process. Four respondents identified experience with the license renewal process and provided comment.

Affiliation	Spaceport Licensing Renewal (Comments/Recommendations)
Spaceport	"Recent inspections and renewal have been through"
Spaceport	"Ability to utilize existing data as part of the submittal for the renewal package was key to keeping renewal costs low. Did not have to regenerate data for items that had not changed."
Spaceport	"The RENEWAL process is not time consuming and I do not have any recommendations for improving the process."
Other	"EELV EIS needs update"

K. License Modifications

The following table provides a summary of the responses related to comments or recommendations on the license modification process. Four respondents identified experience with the license modification process and provided comment.

Affiliation	Spaceport Licensing Modification (Comments/Recommendations)
Spaceport	"Explosive Site Plan, use National Consensus standards"
Spaceport	"In the process of updating our site Operators license to include horizontal launches. FAA has provided guidance on the process"
Spaceport	"We're working to expand our existing LSO license to include two launch complexes. FAA licensing process has been rather straightforward for this modification."
Launch Vehicle Manufacture / Operator	"We modified our license to remove everything but the runways to reduce scope of FAA jurisdiction."

L. General Comments/Recommendations

The following table provides a summary of general comments and recommendations. A total of seven respondents provided additional comments.

Affiliation	Primary Cost Driver
Spaceport	"Perhaps a more checklist-like approach for the application would be helpful for those applicants with limited experience."
Spaceport	"One improvement to the licensing process would be onsite visits by the FAA before and during the licensing process."
Launch Vehicle Manufacture / Operator	"If FAA is regulating something WITHOUT sole jurisdiction -- in other words, if FAA saying "yes" doesn't trump other agencies saying "no" -- then FAA should NOT be regulating in that area."
Launch Vehicle Manufacture / Operator	"Set the rules so that a good engineer can determine whether a site can license, for instance air shows, don't license based upon expected casualty analysis, instead they set flight boxes, and that allows every show to be designed quickly."
Consultant	"The spaceport licensing process should be tailored to the types of launch vehicles operating from the spaceport. Certain components of the regulations are more applicable to different types of launch vehicle. Perhaps a set of guidelines could be developed to identify which requirements are applicable to which types of launch vehicles."
Consultant	"In addition to the earlier requirements I believe that licensing for Professional Engineers in this area should be established. We have such a requirement for certifying buildings, highways and other infrastructure and the exemption of professional

	certification for commercial enterprises related to space is no longer appropriate with the withdrawal of the government from direct design oversight. It would help to perhaps speed and give confidence in the licensing process if you had certified professionals that could buy off the vehicle and the calculations relative to design and public safety for the facility."
Consultant	"Revisit the definitions and assumptions sections in the licensing chapter to ensure that ignition point "away" from the spaceport (i.e jet powered take off and landing" reflect on the licensing requirements-process"
Other	"We started almost 20 years ago - the active work on getting the license started probably in 1998 - things are much better now."
Other	"I am sure the FAA is carefully and mindfully watching to see what Europe decides in the coming months regarding how they will proceed. It is important that we integrate our system and theirs."
Other	"The 'licensing process' needs to be adopted by all parties involved with 'space traffic control' and orbital reentry"

M. General Relevance & Actionable Recommendations

A total of twelve (12) survey respondents answered the question "Do you feel that the licensing process, as is, was relevant to your situation? Of the 12 responses, six responded "Yes", three answered "Somewhat", and three responded with "No". The results of this question were that half the respondents felt that process was relevant in their case.

The following comments were provided to identify specifically what was deemed relevant:

Affiliation	What was relevant about existing licensing process?
Spaceport	"The absolute requirement to conduct launch operations safely"
Spaceport	"Licensing was considered a necessary step for the overall certification of our spaceport."
Spaceport	"The most relevant and time consuming aspect related to the licensing process involved the protection of the uninvolved public."
Consultant	"The general requirements were relevant, however specific usage was not."
Other: Insurance	"As an underwriter, we need the complete picture on risks associated with spaceports."

The following comments were provided to identify specifically what was not deemed relevant:

Affiliation	What was not relevant about existing licensing process?
Launch Vehicle Manufacture / Operator	"Would have cost more than our entire program over ten years of operation."
Launch Vehicle Manufacture / Operator	"It is absurd to have FAA handling ground hazards not unique to spaceflight (i.e., ground preparation). Their standards conflict with existing OSHA, DOT, NFPA standards and they have neither jurisdiction nor competence. Their concern should begin with LAUNCH."
Launch Vehicle Manufacture / Operator	"Scope, risk methods, census bureau rules analysis, not engineering driven"
Consultant	"1) Definition of launch point since ignition occurs elsewhere 2) Propellants provided in Appendix E did not fully match propellants used in industry for RLVs. Appendix E differs from DoD 6055.09 standard. 3) Flight corridor development does not clearly fit for piloted reusable launch vehicles. 4) No information of flight corridors for horizontally launched RLVs 5) Risk analysis for spaceports not really valid until actual RLV vehicle data is available

	6) Misprints in equations in Appendix A & B."
Consultant	"The need to certify for ignition at the site when the spaceport only required ignition in the air away from the property"
Other	"Space Debris collision avoidance and reentry"

The following actionable recommendations were provided:

Affiliation	**Actionable Recommendations**
Spaceport	"Address Emergency Response"
Spaceport	"We found the current regulations to be very reasonable with regards to our licensing effort. However, it could vary from one applicant to another based on a great number of factors that are specific to each individual site."
Launch Vehicle Manufacture / Operator	"Make use of existing legislation where reasonable and applicable. Shut down or drastically curtail the EPA."
Launch Vehicle Manufacture / Operator	"Delete the majority of current part 420"
Launch Vehicle Manufacture / Operator	"Expected casualties is not the process to license, heuristic rules and engineering process is better."
Consultant	Numbered Items below reference numbered items from previous questions: 1) The definition of the launch point can be adjusted to clarify the variations of use, for example that the FAA defines launch different from "ignition" 2) Appendix E should be modified to include information of propellants commonly used in RLVs, ie: Nitrous Oxide and HTPB 3) Additional information on the effect of a piloted RLV should be included in Appendix A & B. 4) Information related to Horizontally launched RLVs should be provided 5) Since a launch vehicle operator must also provide a risk analysis, eliminate the need for a spaceport to complete this analysis prior to a launch operator utilizing the spaceport. 6) Several misprints were identified in equations in Appendix A & B. We've previously submitted a list of 4 misprints to Appendix A and 10 to Appendix B. Since then we've found two more misprints, for Equation B41 & B44.
Consultant	Classification should be based stictly on the amount of energy contained in the vehicle and the total mass, the weight of the payload has nothing to do with the licensing criteria and public safety. The spaceport should apply for a maximum energy vehicle and mass combination. The table on the inclination of the orbit is limited to only two degree locations and no translation information was provided.
Consultant	"Make the process modular to right scope-scale "each" project based on the characteristics of: 1.1 Vehicles 1.2 Flight Plan 1.3 Property and surrounding area profile"
Other	"Harmonize all space national directives for space debris"

Appendix C – Supplement to Survey Responses

The following comments/recommendations were provided by Jeff Greason as a supplement to the survey response, specifically on the topic of "Recommendations for Replacing FAA Regulation 14 CFR Part 420".

-- Supplemental Recommendations and Comments Provided by Jeff Greason --

Recommendations for Replacing FAA Regulation 14 CFR 420

The COMSTAC STOWG commissioned a subgroup to make recommendations for the future structure and role of FAA in licensing spaceports. Regulation 14 CFR 420, which is currently in place, is a light version of the regulations that were in place in the mid-1990s for large, expendable launch vehicles (ELVs) at Federal ranges. These ELV launches are not comparable to launches planned for commercial spaceports, and therefore the FAA regulations for commercial spaceports can and should be substantially different.

The difference between ELV and sRLV operations

ELVs launched from Federal ranges:

- Contain very large amounts of propellant
- Are intended for only one use, and thus typically are fragile
- Typically carry substantial quantities of highly toxic substances.

As a result, Federal ranges launch ELVs from extremely remote sites with very large distances from range crews and human populations. These launches occur infrequently.

The ELV approach differs from the commercial launch industry, which is evolving toward fully and partially reusable suborbital launch vehicles (sRLVs). sRLV are expected to launch from mixed-use commercial facilities, such as airports, that have ongoing commercial operations, such as the takeoff and landing of airplanes, occurring concurrently with space launch activities.

The sRLVs also have operating characteristics very different from large expendable launch vehicles. SRLVs:

- Are serviced by small crews
- Include multiple safety mechanisms
- May be human-rated and piloted
- Typically do not employ toxic or otherwise highly hazardous propellants.
- Are launched frequently, even several times a day.

Only three areas for regulation

The key role of FAA in commercial space launch is to preserve the safety of the uninvolved public, while encouraging, facilitating and promoting the commercial space launch industry. Because sRLVs and their launch sites are very different from ELVs and Federal ranges, it's necessary to rethink the FAA's role in licensing commercial launch sites called spaceports.

The COMSTAC working group asked the question: "Why should the FAA regulate sRLVs?" The answer informed our recommendations. In response, we recommend the spaceport be required to comply with only three requirements:

1. Identify at least one vehicle that can safely launch from the spaceport.
2. Demonstrate the spaceport complies with existing environmental regulations
3. Demonstrate that spaceport services are adequate and comply with local regulations in delivering such services.

Show that at least one sRLV can safely launch from the site

The current FAA 14 CFR 420 has at its core the requirement for a spaceport operator must show that there is at least one kind space launch vehicle that can operate safely from the facility. COMSTAC recommends this as the core of the new regulatory approach, as well. The spaceport should show, as it does today, that, when operating sRLV launches from the proposed launch site, all of the safety assessments relevant to licensing the launch, such as expected casualty analysis, demonstrate adequate public safety.

-- Supplemental Recommendations and Comments Provided by Jeff Greason --

Demonstrate the spaceport complies with existing environmental regulations
Environmental stewardship requires Federal regulations, which are already in place through the Environmental Protection Act and local regulations. An Environmental Assessment (EA) and, if needed, the relevant further actions should be required before commencing space launch activities at a proposed spaceport that has not previously hosted launch activities. Site-specific EA should be required before commencing operations; therefore, there needs to be a Federal mechanism for a spaceport to start such an assessment in anticipation of sRLV launches.

Demonstrate adequate spaceport services and comply with local and national regulations
Vehicle operators will depend on certain site services. Thus, the spaceport operator should be required to demonstrate that it provides the necessary services adequately. A troublesome element of 14 CFR 420, however, is a lack of regulation in some areas, and extreme overregulation in other areas.

Because most sRLV launch activities will be at commercial facilities with other concurrent operations, COMSTAC recommends the FAA start from a zero-based approach and build the requirements from there. In most cases, we recommend against the FAA developing new regulations or specifying the contents of a plan, but instead the FAA's role should be to ensure that the spaceport has documented its plans and complies with regulations set by its local and National authorities. The spaceport should be required to develop plans for the following:

Cooperative use of airspace
A spaceport should be required to show that it has procedures in place for the cooperative use of the airspace that sRLVs will traverse on their way to and from space. This airspace coordination plan should be developed in cooperation with existing airspace authorities – for example, in Mojave that would be SOCAL in Los Angeles and JOSHUA around Edwards Air Force Base. The spaceport will need a mechanism in place for filing flight plans or other documents to notify affected airspace authorities of flights in a timely manner. The regulation should not say WHAT these procedures should be – only that it be documented.

Emergency response services
The spaceport should also be required to have an emergency response services and a plan. The spaceport should have a plan for hazardous spills, injuries and fires. Relevant authorities and responders need to be identified and a mechanism put in place to notify them in an emergency. If there are special hazards associated with the sRLV that will launch from the spaceport, first responders need to be notified of the specifics in advance, such as chemicals used, so respondents can be prepared in an emergency. In addition, there should be a documented plan for how injured persons will get medical services. The regulation should not say WHAT these plans and procedures should be – only that they exist and that they contain the required elements.

Advisory system for lightning
A rocket exhaust plume can guide lightning to the ground like a lightning rod. The spaceport needs to provide a lightning advisory system to meet the needs of the sRLVs operating at its facility. How much warning an sRLV operator needs and how far away the lightning may be while still operating safely will vary, so like the other regulations we are proposing, we do not recommend the FAA set a specific standards, but that FAA should require the proposed spaceport identify what lightning warning is needed for the sRLVs operating at that site and show that an appropriate warning system is in place.

Storage and handling of energetic materials
Energetic materials, such as solid rocket propellants, fuels, oxidizers and compressed gasses will be stored and handled at the launch site. The FAA should require the spaceport document its standards and show that they comply with existing regulations from authorities with jurisdiction over the site, such as the Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and fire authorities, which will typically employ the standards of

the National Fire Protection Association (NFPA) and the Compressed Gas Association (CGA). In addition, some sites will have additional local authorities with jurisdiction, such as sites that are collocated with a Federal range, or as another example, the Mojave Spaceport operates under air pollution regulations set by the East Kern Air Quality Management District.

We strongly recommend against the FAA trying to set new standards, since existing authorities have already set functional standards. Local standards vary due to different climates, vegetation, and population densities. Local standards are best. The FAA should ensure that a spaceport has complied with existing local and national standards.

For further thought: How strongly should we encourage new spaceports?

This question is not a pressing public policy issue but it may become so at a later time. Spaceports consume limited resources, such as local airspace, taxpayer funds and FAA regulatory oversight. While COMSTAC does not want the FAA to restrict the formation of spaceports, if there becomes a policy concern that the country is investing in more spaceports than can be supported by demand, the FAA could add an additional requirement: a spaceport might be required to provide evidence that a vehicle provider of its proposed type of sRLV has intent to operate from that spaceport, which is not required today.