Office of the Associate Administrator
for Commercial Space Transportation (AST)
Federal Aviation Administration (FAA)
Department of Transportation (DOT)

VOLUME 2:
COMMENT RESPONSE DOCUMENT FOR THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR LICENSING LAUNCHES

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FINAL

Prepared by
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EXECUTIVE SUMMARY

In accordance with the National Environmental Policy Act (NEPA) the Federal Aviation Administration (FAA) initiated a 45-day public review and comment period for the Programmatic Environmental Impact Statement (PEIS) for Licensing Launches. The PEIS was prepared to (1) update a 1986 Programmatic Environmental Assessment for Commercial Launch Vehicles; (2) work in conjunction with other environmental documentation to support licensing of licensed launches; and (3) document compliance with NEPA requirements. In October 1998, FAA's regulatory role in licensed launch activities was enlarged to include licensing reentries and the operation of reentry sites; therefore, these are included in the PEIS.

Fifteen sets of comments were received regarding the Draft PEIS for Licensing Launches during the public comment period. These comments were categorized into four groups of submitters: Government agencies, academia, industry, and private citizens. Specific comments were received from the following government agencies: NASA, SMC/AXFV USAF (Jerry Olen), SMC/AXFV USAF (Theodore Krawczyk), California Coastal Commission, U.S. Department of the Interior, and U.S. Environmental Protection Agency. Comments were received from one academic organization, the University of Southern California. Additional comments were received from industrial organizations including Aerospace Corporation, The Boeing Company, Environmental Rocket Propulsion Society, Kistler Aerospace, Space Access, and Vela Technology Development, Inc. FAA also received comments from one private citizen.

The comments were further categorized by subject matter and were each coded into one of the following topic areas: editorial, air quality, cumulative impacts, launch manifest, noise, programmatic content, propellants, safety, wildlife, and other. To facilitate the organization of the comments, an index was developed that grouped the comments by topic area only. The Table of Contents cross-references the Index for quick reference to responses by topic area. Appendix A provides statistics on the characteristics of comments received during this process.

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FOREWORD

This volume of the Programmatic Environmental Impact Statement for Licensing Launches is divided into three sections based on the source of the comment. Each comment is addressed individually. The text provided by the commentor was not altered to correct for grammatical or spelling errors. When the comment provided by the commentor was an opinion FAA replied that the "comment was noted" however, no additions were made to the text of Volume 1 of the PEIS.

Due to the composite nature of this document a Table of Contents and an Index are included to enhance readability. Each comment was analyzed to determine the key topic addressed. Section number, comment number, and subject matter reference each comment in the Table of Contents, Responses, and Index.

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TABLE OF CONTENTS

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GOVERNMENT AGENCIES

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1.0 NASA

General Comments

1.1 Comment 1 [Programmatic Content]

When referring to the preferred alternative, the actual launch vehicles should be listed. Throughout the document commercial LVs are mentioned and compared to other LVs. Without calling out which specific vehicles are considered commercial LVs, as opposed to "non-commercial" LVs, the discussion is unclear.

FAA Response 1:

The Draft PEIS was designed to accommodate existing, proposed, and future vehicles used for licensed launches, and to do this FAA considered ranges of LV characteristic and launch profiles rather than specific vehicles. A specific listing of vehicles used for licensed launches would be unnecessarily limiting for programmatic purposes especially with the on-going dynamics within the industry. The major distinction made was expendable versus reusable launch vehicles. For further discussion of these launch vehicle types, please see the Executive Summary, Section 1.4, 2.2.1, and 2.2.3 of the PEIS. In addition, specific vehicle descriptions and assessments of potential environmental impacts will be addressed in site-specific environmental documentation.

1.2 Comment 2 [Programmatic Content]

Suggest specifically mentioning launch sites within the regions of interest discussed. Potential environmental impacts can not be adequately covered without some level of specificity. Strongly suggest adding a minimal set of site specifics to regional discussions (i.e., mention by name the launch site in the region, T & E species in the locale, and any significant site specific environmental concerns [pinnipeds/least tern at VAFB, etc.]. Avoiding high order specifics/local environmental concerns makes the purpose of the document unclear.

FAA Response 2:

The Draft PEIS is meant to be used as a tiering document. This document will minimize the amount of work required to be completed by a license applicant and allow the applicant to focus on environmental impacts specific to their vehicle and/or site design and operations. Because this document is designed to be used by future launch site operators to facilitate the completion of their environmental documentation it would not be appropriate for the Draft PEIS to list existing launch sites specifically. In fact, information that discusses the regional environmental characteristics of launch sites was incorporated into the PEIS from documentation for existing and proposed launch sites. It should also be noted that the PEIS would not replace the need for site-specific environmental documentation. Therefore, the impacts of any proposed project on T&E species and other specific environmental concerns will be addressed to the extent to which they apply to any particular license applicant's proposed operations.

1.3 Comment 3 [Wildlife]

The breadth of discussion/analysis of marine mammal strikes could be considered unwarranted considering the low probability of occurrence. It may also be construed as disingenuous as more

probable and more potentially damaging environmental impacts seem to be discussed with brevity when compared to the marine mammal discussion. For example, what is not investigated in the marine mammal analyses is the effect of acoustic shock on marine mammals (across a much larger area than the size of impacting hardware), and the effects of residual propellants on the marine environment.

FAA Response 3:

This document is not intended to give the appearance of devoting too little or too much discussion to any one topic. The probability of a marine animal strike is discussed in Section 5.3.5 of the PEIS. The marine animal strike probability calculations were included in the Draft PEIS because they could be presented in such a way as to address all possible launch vehicles flying over coastal environments without the need to reference a specific site. Research on acoustic (sonic boom) impacts on marine mammals and fish is ongoing. As research continues and new information becomes available it will be included in the PEIS and in site specific environmental documentation as appropriate. If there are specific resources that are available which have not been considered, FAA would welcome the information. The effects of residual propellants on marine animals are also considered an important area of study. However, propellant types vary from vehicle to vehicle and the specific marine life impacted by the propellants will vary from site to site, hence these impacts are best addressed in site-specific or vehicle-specific environmental documentation as well as in ongoing monitoring studies.

1.4 Comment 4 [Editorial]

Inconsistent use of conditional language throughout document – need to consistently use the conditional tense (i.e., would, could vs. will)

FAA Response 4:

This comment will be addressed in the final version of the PEIS.

1.5 Comment 5 [Editorial]

All acronyms should be spelled out the first time used.

FAA Response 5:

This comment will be addressed in the final version of the PEIS.

1.6 Comment 6 [Other]

p vii, Executive Summary
Suggest addition of potential orbital debris impacts and orbital debris mitigation discussion here and throughout document.

FAA Response 6:

A discussion of orbital debris and orbital debris mitigation will be added to the PEIS in this and other relevant sections. The following text has been added as a new Section 3.1.5:

> *Orbital debris is defined as man-made space debris that remains in Earth orbit during its lifetime. This debris has no impact on the human environment as defined by NEPA unless and until the debris enters the Earth's atmosphere. Unlike meteoroids, or natural debris, which are part of the space environment and sweep through Earth orbital space at an average speed of 20 km/sec, orbital debris remains in Earth orbit creating potential acute and cumulative impacts on satellites and other space objects. Three types of orbital debris are of concern on orbit: (1) objects larger than 10 cm in diameter, commonly referred to as large objects, which are routinely detected, tracked, and cataloged; (2) objects between 1 and 10 cm in diameter, commonly referred to as risk objects, which cannot be tracked and cataloged; (3) objects smaller than 1 cm in diameter, commonly referred to as small debris or in some sizes microdebris. The interaction among these three classes combined with their long residual times in orbit creates concern that there may be collisions producing additional fragments and causing the total debris population to grow, which may increase the chance of reentry into Earth's atmosphere.*
>
> *Debris in each of these classes can be generally classified into four source categories. Operational debris are composed of inactive payloads and objects released during satellite delivery or satellite operations, including lens caps, separation and packing devices, spin-up mechanisms, empty propellant tanks, spent and intact vehicle bodies, payload shrouds, and a few objects thrown away or dropped during manned activities. Fragmentation debris result from either collisions or explosions. Deterioration debris is very small debris particles created by the gradual disintegration of spacecraft surface as a result of exposure to the space environment, including paint flaking and plastic and metal erosion. Solid rocket motor ejecta results from the ejection of thousands of kilograms of aluminum oxide dust from solid rocket motors into the orbital environment.*
>
> *The effects of orbital debris impacts depend on velocity, angle of impact, and mass of the debris. For debris of sizes less than 0.01 cm, surface pitting and erosion are the primary effects. Over a long period of time, the cumulative effect of individual particles colliding with a satellite might become significant since the number of particles in this size range is very large in Low Earth Orbit. Although solid rocket motor ejecta are very small, (less than 0.01 cm) long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces, chemical contamination, and may degrade operations of vulnerable components such as optical windows and solar panels. Debris of sizes 0.01 cm to 1 cm produce serious damage which, depending upon system vulnerability*

and defensive design provision, can result in structural damage to the satellite. Mitigation measures can be employed to shield against debris particles up to 1 cm in diameter. Objects larger than 1 cm can produce catastrophic damage.

In addition Section 9.7 has been added to the document and the text reads as follows:

Although orbital debris is in outer space, it is possible that it could reenter Earth's atmosphere. Likely impacts would be insignificant but the FAA does require applicants to demonstrate certain safety measures in order to receive license approval. While these launch plan features are not required for environmental purposes and the orbital debris outside the Earth's atmosphere are not an impact category, the requirements could have a beneficial mitigating effect. The more orbital debris, the greater the likelihood debris could reenter Earth's atmosphere; and therefore efforts to minimize the amount of debris have an added benefit beyond safety as mitigating detrimental impacts. To obtain safety approval, an applicant must demonstrate for any proposed launch that for all launch vehicle stages or components that reach Earth orbit – (a) There will be no unplanned physical contact between the vehicle or its components and the payload after payload separation; (b) Debris generation will not result from the conversion of energy sources into energy that fragments the vehicle or its components. Energy sources include chemical, pressure, and kinetic energy; and (c) Stored energy will be removed by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy. Other equivalent procedures may be approved in the course of the licensing process. Additional mitigation measures may be employed to shield against debris particles up to 1 cm in diameter. For debris of larger sizes, current shielding concepts may become impractical. Advance shielding concepts may make shielding against particles up to 2 cm diameter reasonable, but it is possible that the only useful alternative strategy for large particles will be avoidance, which is feasible for average size spacecraft, but for very large spacecraft collision probabilities are sufficiently high that an alternate means of protection may be required.

Launch planning may help to protect launch vehicles and payloads from potential damage. Although there are no measures to significantly modify the current debris environment, there are options available to control, limit, or reduce the growth of orbital debris in the future including:

- *Obtaining a conjunction on launch assessment from U.S. Space Command.*
- *Booster and payload design to minimize release of debris.*
- *Preventing spontaneous explosions of launch vehicle bodies and spacecraft.*

- *Use of particle-free propellants.*
- *Disposal or deborbiting of spent upper stages or spacecraft.*
- *Careful mission design to actively remove debris.*
- *Launch vehicles and spacecraft can be designed so that they are litter-free (i.e., they dispose of separations devices, payload shrouds, and other expendable hardware at a low enough altitude and velocity that they do not become orbital).*
- *Stage-to stage separation devices and spacecraft protective devices such as lens covers and other potential debris can be kept captive to the stage or spacecraft with lanyards or other provisions to minimize debris.*
- *When stages and spacecraft do not have the capability to deorbit, they can be made as inert as feasible by expelling all propellants and pressurants and assuring that batteries are protected from spontaneous explosion.*
- *No unplanned physical contact between the vehicle or its components and the payload after payload separation.*
- *When the mission requires delivery of a spacecraft which itself has a maneuver capability, two alternatives are possible.*

1. *One is to leave the upper stage attached for delivery of the spacecraft to orbit to maximize its maneuver capability.*
2. *The second is to separate the spacecraft at suborbital velocity so that the stage decays naturally and the spacecraft uses its onboard propulsion to establish its orbit.*

1.7 Comment 7 [Editorial]

The proper abbreviation for pounds is lb, not lbs.

FAA Response 7:

This comment will be addressed in the Final PEIS.

1.8 Comment 8 [Editorial]

p. ix, ES.2.2 and throughout document
Suggest the use metric units followed by an English-unit parenthetical throughout document.

FAA Response 8:

This change was not made in the final version of the document.

1.9 Comment 9 [Editorial]

Figures 2-1 through 2-5 are missing from the PDF files pulled from the web. Most other figures are too small to be useful. Suggest making all figures available and large enough to see easily.

FAA Response 9:

For technical reasons, Figures 2-1 through 2-5 were not available electronically for the Draft PEIS. FAA's website states "Figures 2-1, 2-2, 2-3, 2-4, and 2-5 are not available on the web." Other graphics will be examined and modified as necessary throughout the document.

1.10 Comment 10 [Air Quality]

Often ozone depleting chemicals are discussed in the same paragraph as greenhouse gas-effecting chemicals. These should be consistently kept separate since they are two separate/distinct topics/mechanisms.

FAA Response 10:

FAA believes that Section 5.1.2 of the PEIS provides a clear description of Global Warming and Ozone Depleting Substances. This Section has two sub headings, one for Global Warming and one for Ozone Depleting Substances. Therefore, no change has been made to the document based on this comment.

1.11 Comment 11 [Other]

NEPA requires that a document be accessible to the public, which means it must be written in language that a lay person of 12th grade non-science-based education can easily understand. Suggest that the preparers review the Plain Language web site linked to the Federal Register web site for a discussion of what constitutes plain language:
http://www.nara.gov/fedreg/plainlan.html#top

FAA Response 11:

Every effort has been made to create a reader-friendly document that thoroughly discusses all relevant topics for this type of document. Launch vehicles and their scientific impacts on the natural environment are by their nature not simple topics. This document attempts to adequately address all impacts in a manner that is accessible to a lay person, however, this cannot be accomplished at the expense of glossing over relevant technical or scientific issues. FAA will address specific instances where language can be simplified as deemed appropriate in the PEIS.

1.12 Comment 12 [Wildlife]

Section 3.3.4,
Mention of endangered and threatened species for each regional environment is not consistent. Suggest addition of regional and/or site specific species of concern.

FAA Response 12:

A brief listing of regional threatened and endangered species has been added to the document; however, it should not be considered a comprehensive accounting for listed threatened or endangered species. Threatened and endangered species are best addressed in site-specific environmental documentation. Environmental review and documentation is required for all license applicants; this review and documentation will consider and specifically identify any threatened and endangered species as appropriate.

Specific Comments

1.13 Comment 13 [Editorial]

p. viii, 2nd bullet under 1st para
Suggest change in wording to "the mechanisms that change the mass and velocity of the vehicle"

FAA Response 13:

This comment will be addressed in the final PEIS.

1.14 Comment 14 [Air Quality]

p. ix, ES.2.3, suggest moving discussion of acid rain to Land and Water paragraph, since HCl rained out of the atmosphere could constitute an impact to soil and/or surface water.
Suggest rewording 4th sentence under Atmosphere to read something on the order of, "Increased rainfall and/or humidity in an area would likely reduce HCl concentrations from SRMs."

FAA Response 14:

FAA believes that the acid rain discussion should stay in the Atmosphere paragraph because the discussion focuses on generation and deposition of acid rain in the atmosphere rather than direct effects on the land and water.

FAA edited the 4th sentence under Atmosphere to read: "The hydrogen chloride (HCl) emissions from solid rocket motors react with moisture in the air and are rained out, thereby reducing the HCl load in all layers of the Earth's atmosphere."

1.15 Comment 15 [Editorial]

p. x, ES.2.3, Biological Resource 3rd para,
Suggest that ELV be defined in a footnote to reduce the length of this sentence and for ease of reading.

FAA Response 15:

This definition will be deleted from ES 2.3 as ELVs are defined earlier in the Executive Summary.

1.16 Comment 16 [Propellants]

p. xi, ES.3.1, 5th sentence, 1st para
Unless what is meant by multi-propellant LVs is really untested hybrids, suggest contacting Range Safety Office of CCAS and VAFB to discuss extensive REEDM analyses that have been run for multi-propellant LVs.

FAA Response 16:

Hybrids are not the same as multi-propellant systems for launch vehicles. There are currently no licensed launch vehicles using hybrid systems although research is being conducted on the feasibility of using these propellants. Multi-propellant systems are used commonly and these modeling results are included throughout the PEIS.

1.17 Comment 17 [Editorial]

p. xi, ES.3.1, next to last sentence,
Suggest inserting word "Overall, emissions of concern . . . "

FAA Response 17:

This change will be made in the final PEIS.

1.18 Comment 18 [Editorial]

p. xii, ES.3, second paragraph, p. xiii, ES.4.2, 2nd paragraph, 2nd sentence
Suggest change wording from "launch sites" to "launches"

FAA Response 18:

This comment will be addressed in the final PEIS.

1.19 Comment 19 [Editorial]

p. xii, ES.4, line beginning with "49 U.S.C. § 70105."
Looks like text was inadvertently deleted here.

FAA Response 19:

The text "49 U.S.C. § 70105" is the reference cite for the preceding sentence.

1.20 Comment 20 [Launch Manifest]

p. xiii, ES.4,
Please be specific about what U.S. government payloads have been launched by the U.S. commercial space launch industry. Please specify which LVs are considered commercial LVs. Question the validity of the statement that limited access to commercial LVs could impact the U.S. Government's ability to launch its needed payloads. Please consult the USAF EELV FEIS or SEIS.

FAA Response 20:

If a government agency remains substantially involved in a commercially procured launch, the launch does not require a license from the FAA. However, the FAA licenses launches of this type if requested by another government agency. For example, in 1999, the Navy requested that the FAA license the November 21 launch of an Atlas 2A launch vehicle carrying the GBS-10 satellite for the U.S. Navy. The Navy procured 10 GBS satellites and their launch from Hughes Space & Communications through a contract for in-orbit delivery, meaning the Navy took possession of the satellites only after they were in-orbit and operating nominally. The only other FAA-licensed launch dedicated to U.S. government payloads in 1999 was that of Terriers and Mublcom on a Pegasus XL on May 17.

Specific launch vehicles are not considered commercial or non-commercial, per se, rather it is the fact that a launch is being conducted by a private citizen (or company) that requires a license. For example, a launch of a Delta 2 carrying a GPS satellite is conducted by the Air Force, which in turn contracts for hardware and services from

Boeing, Delta's manufacturer. If, on the other hand, a Delta 2 launch is conducted carrying commercial payloads, such as the Iridium or Globalstar satellites, Boeing is the launch operator, not the Air Force, and therefore must obtain an FAA license.

Over the past five years, between 2 and 5 FAA-licensed launches each year have been for U.S. government agencies. In these cases, the U.S. government agency involved chose to purchase licensed launch services instead of a traditional government procurement because it was less expensive, required less government oversight, and took advantage of commercial insurance and liability indemnification. Without access to licensed launch services, the higher cost and increased resources necessary to use traditional government procurement practices would impact the ability of the U.S. government to conduct launches of scientific payloads and routine communications payloads typically launched commercially.

1.21 Comment 21 [Launch Manifest]

p. xiii, ES.4.2, 2nd paragraph, 3rd line from bottom of page
Question the validity of the argument that U.S. launch sites would go underutilized – suggest preparers review USAF EELV FEIS and SEIS.

FAA Response 21:

This statement has been deleted from Section ES.4.2 .

1.22 Comment 22 [Air Quality]

p. xv, ES.5.1, last sentence of 2nd paragraph,
The local UV intensity near a launch site would not necessarily be expected to change due to a launch or launch accident; global ozone depletion impacts should be investigated as opposed to local UV increases.

FAA Response 22:

Global ozone depletion is considered in Section 8 of the PEIS.

1.23 Comment 23 [Safety]

p. xv, ES.5.1, 1st sentence of 4th paragraph,
In-flight termination systems are required on all known LVs launching from US ranges. Lack of an FTS would seem to constitute a safety issue for the general populace, perhaps even in the case of a sea-launch.

FAA Response 23:

For each launch, a launch operator shall employ a flight safety system that provides a means of control during flight for preventing a launch vehicle and any component, including any payload, from reaching any populated or other protected area in the event of a launch failure. The FAA has licensed launches from sea which do not posses an FTS as defined here, but provide other means of achieving an equivalent level of safety. See Licensing and Safety Requirements for Launch, Notice of Proposed Rulemaking, 65 FR 63921, 63940.41 (October 25, 2000).

1.24 Comment 24 [Safety]

p. xv, ES.5.1, next to the last sentence of 4th paragraph,
Please consider that accidents are not so rare when discussing new launch systems; invariably, there is a higher probability that an accident will happen within the first few flights.

FAA Response 24:

Accidents do occur in both new and existing launch systems. The FAA uses an expected failure rate of 10% which was chosen as an acceptably conservative value while not overly penalizing seasoned launch vehicles. The first three flights of a new vehicle generally have a failure rate of around 30%. All new flight systems proposed for launch by U.S. entities will need to undergo thorough environmental review and mission safety review in order to obtain a launch license from the FAA. The probability of accidents will be addressed individually in vehicle-specific license applications. See 14 CFR § 417.227 (b)(6)(i)-(iv). New launch vehicles may launch "dummy" payloads on initial missions to "prove" the feasibility of their designs or they may conduct test launches to demonstrate their feasibility.

1.25 Comment 25 [Editorial]

p. 1, 1.1., line 7,
Is: ". . . Federal Aviation Administration, (FAA) . . ."
Should be: " . . . Federal Aviation Administration (FAA), . . ."

FAA Response 25:

This change has been made in the final version of the PEIS.

1.26 Comment 26 [Editorial]

p. 1, footnote c,
Is: "reuse these components and reusable launch vehicles . . ."
Should be: reuse these components, and reusable launch vehicles . . ."

FAA Response 26:

The statement has been revised to read: "Launch Vehicles (LVs) in this PEIS are comprised of both expendable launch vehicles (ELVs) that have stages or components that are not intended for recovery or reuse, and reusable launch vehicles (RLVs) that have stages or components that can return to Earth and be recovered and reused."

1.27 Comment 27 [Editorial]

p. 2, 1.4,
Paragraph is confusing. Footnote c on previous page states that this PEIS includes RLVs, but paragraph contradicts that statement. To what is "49 U.S.C. § 70101 (13) a reference? Suggest using a consistent convention for references.

FAA Response 27:

An RLV is a reusable launch vehicle. Section 1.4 of the PEIS states that reentry vehicles will not be considered in the PEIS. In addition, the document states that for purposes of

the PEIS, reentry vehicles will include those vehicles fitting the description of reentry vehicles that are not also RLVs. This description shows RLVs as being a subset of reentry vehicles. The PEIS will therefore consider only the smaller subset.

The cite references the preceding sentence. The FAA used The Bluebook: A Uniform System of Citation, Columbia Law Review et al. eds., 16th ed. 1996 as the source for legal citations, including statutory references.

1.28 Comment 28 [Editorial]

p. 6, 2.2.1,1st paragraph, 1st line,
Insert (LEO) after Low Earth Orbit

FAA Response 28:

The phrase "Low Earth Orbit" will be replaced with the acronym "LEO" as this term was defined previously in the PEIS.

1.29 Comment 29 [Launch Manifest]

p. 6, 2.2.2,
It is unclear as to whether or not these forecasted numbers include AF and NASA launches, or if they are just commercial launches. Please specify.

FAA Response 29:

The forecast numbers included in the PEIS include only licensed launches, not USAF or NASA government launches. Section 1.4 describes the types of launches the FAA considered in the PEIS to include, "…licensed launches from existing government launch facilities, licensed launches from launch sites developed at or near government launch facilities, and licensed launches from launch sites that would require new development and construction.

Therefore, only licensed launches were considered in the body of the PEIS. In addition, the heading of Section 2.2.2 has been revised to read Licensed Launch Estimates.

1.30 Comment 30 [Editorial]

p. 6, 2.2.2, 2nd paragraph,
Is: "U.S. small capacity commercial launches are defined as LVs of less than 2,000 lbs GTO or less than 5,000 lbs LEO, . . ."
Should be: "U.S. small capacity commercial launches are defined as LVs capable of launching payloads of less than 2,000 lb to GTO or less than 5,000 lb to LEO, . . ."

FAA Response 30:

The sentence has been revised to read "U.S. small capacity launches are defined as launch vehicles capable of launching payloads of less than 2,000 lb to GTO or less than 5,000 lb to LEO."

1.31 Comment 31 [Launch Manifest]

p. 6, 2.2.2, 2nd paragraph, last sentence,
Upon what assumptions are these internal AST estimates based? Need more insight into how these numbers were determined.

FAA Response 31:

Internal FAA estimates are based on publicly available forecasts of worldwide commercial launch demand and estimates of the U.S. market share capture of that worldwide demand. The estimates also include assessments of the number of FAA-licensed launches of U.S. government payloads and sounding rockets, which are typically not included in the worldwide forecasts of commercial launch activity. In this instance, the forecasts used were the COMSTAC Commercial Mission Model Update, published May 1998, which forecasts demand for launches of commercial payloads to geosynchronous orbit (GSO), and the FAA's 1998 LEO Commercial Market Projections, published May 1998, which forecasts demand for launches of commercial payloads to all non-geosynchronous orbits, including low Earth orbit (LEO), medium Earth orbit (MEO), and elliptical orbits. Estimates of the U.S. market share capture are slightly higher than historical percentages which have varied between 30 and 47 percent of the worldwide market over the past five years. This is due to the expectation that U.S. launch services providers will continue to capture more of the international market.

1.32 Comment 32 [Launch Manifest]

p. 7, 2.2.2, first paragraph on page
Number of small capacity launches for 1998 should be based on actuals [sic.], rather than based on estimates. Suggest updating Table 2-2 with 1999 AST numbers.

FAA Response 32:

All launch numbers in the PEIS have been updated to reflect the proposed schedule of launches between 2000 and 2010.

1.33 Comment 33 [Editorial]

p. 7, 2.2.2, 3rd paragraph on page, last sentence,
Should be in the passive voice: suggest rewording sentence to take out the word, "we."

FAA Response 33:

This change will be made in the Final PEIS.

1.34 Comment 34 [Propellant]

p. 9, 2.2.3, 2nd para, 2nd sentence,
Should note that RP1 is thermally stable kerosene, and spell out RP1 (Rocket Propellant 1) the first time it is used.

FAA Response 34:

This change will be made in the Final PEIS.

1.35 Comment 35 [Editorial]

p. 11, Table 2-5,
Suggest using some other fill such as cross-hatching or patterns so that the table is readable.

FAA Response 35:

This graphic has been modified because the proposed high capacity launch vehicle has been licensed by FAA and is available for operation.

1.36 Comment 36 [Editorial]

p. 11, 2.2.3, 2nd para on page,
Needs to be more clear: Usually SRMs augment a first stage; for example, Delta II's and III's use a liquid first stage augmented by SRMs, and a different liquid propellant for the 2nd stage.

FAA Response 36:

This statement will be revised to clarify that SRMs are used in many vehicles as a booster to supplement the first stage of the launch vehicle.

1.37 Comment 37 [Editorial]

p. 12, 2.2.3, 2nd para on page, line 7,
Suggest moving the sentence, "The hybrid propulsion system would consist of a solid . . ." to the end of the previous paragraph.

FAA Response 37:

The following statement was added to the preceding paragraph "A hybrid propulsion system would consist of a solid propellant (powdered aluminum in a polymer matrix) with a liquid cryogenic oxidizer (liquid oxygen)."

1.38 Comment 38 [Editorial]

p. 12, 2.2.3, 2nd para on page, line 11,
Is: "However, a reusable vehicle with intermediate payload capacity is under development; the vehicle . . ."
Should be: "However, reusable vehicles with intermediate payload capacity are under development; one such vehicle . . ."

FAA Response 38:

This change has been made in the final version of the PEIS.

1.39 Comment 39 [Other]

p. 17, Table under Figure 2-5;
Since SRMs cannot be shut down after ignition, the main engine is ignited first to make sure it does ignite, prior to igniting the SRMs. There are no known LVs that utilize such an ignition sequence.

FAA Response 39:

The liftoff thrust of the Titan III and IV is provided solely by the two SRMs which constitute Stage 0. The SRMs provide all of the initial flight thrust and control. As SRMs burnout, the vehicle avionics sense the deceleration and command the core stage to ignite and SRMs are jettisoned.[1]

1.40 Comment 40 [Other]

p. 18, 2.3.1,
A more viable alternative might be one in which only vehicles with liquid or combinations of liquid and solid propellants are licensed, including vehicles that have first stages augmented by SRMs (i.e., an alternative in which vehicles propelled solely by solid propellants [Athena, Taurus, Pegasus] are not licensed).

FAA Response 40:

This alternative would impact a limited number of launch vehicles and FAA believes that this alternative is not substantially different from the preferred alternative, therefore this would not fulfill the purpose and need of the PEIS.

1.41 Comment 41 [Propellants]

p. 18, 2.3.4,
This Section ignores the fact that hydrazine/nitrogen tetroxide and kerosene/LO_x liquid propellants are potentially more environmentally damaging than LO_x/LH_2. There seems to be a bias against solids propellants. Section 5.1.2 does mention that "Initial results from (the RISO) study have indicated that LO_x kerosene engines may be more potent in ozone depletion than previously expected." This section also references the fact that further research is being done in this area.

FAA Response 41:

No bias against solid propellants was intended. Indeed, the statement about the RISO study was specifically included in Section 5 to provide the reader with the most updated information in the debate over the real environmental impacts of solids versus other types of propellants. FAA is aware of these recent studies and will incorporate any new data developed on the environmental impacts associated with solid propellants in the final version of the PEIS. Such studies will also be included in any launch or site specific environmental assessments and documents as appropriate.

1.42 Comment 42 [Air Quality]

p. 20, 2.4.1, para on Air Emissions,
NO_x is not mentioned as an ozone-depleting chemical. Also, other criteria pollutants such as carbon monoxide and particulate matter are not mentioned.

[1] Steven J. Isakowitz. International Reference Guide to Space Launch Systems 2nd edition. AIAA. Washington, DC (1994).

FAA Response 42:

NO_x is mentioned in Section 5.1.1 as being an ozone depleting substance. It will also be specifically mentioned in Section 2.4.1. Section 3.1.1 of the PEIS discusses the National Ambient Air Quality Standards and mentions the identified criteria pollutants including carbon monoxide and particulate matter.

Section 2 of the PEIS is intended to generally outline the major issues associated with the various alternatives considered in detail in the remainder of the document. Section 6 of the document outlines in detail the impacts associated with the "More Environmentally-Friendly Propellant Combinations Alternative." In Section 6.1 impacts to air quality associated with this alternative are considered in detail.

1.43 Comment 43 [Editorial]

p. 21. 2.4.2, next to the last sentence of the 1st para
Is: "The agency may prevent . . ."
Suggest: "The agency has the authority to prevent . . ." (Wouldn't the agency have a mandate to prevent a launch if public safety would be jeopardized?)

FAA Response 43:

This comment will be made in the final version of the PEIS.

1.44 Comment 44 [Editorial]

p. 23, Table 3-1,
Altitude ranges for various atmospheric layers do not match those listed in section ES-2.

FAA Response 44:

The figures for ranges of the atmospheric layers cited in the Executive Summary will be revised to match those cited in Section 3 of the PEIS.

1.45 Comment 45 [Air Quality]

p. 23, 3.1.1, last sentence in first paragraph,
NO_x is also a key ingredient of photochemical smog production.

FAA Response 45:

The last three sentences in this paragraph were written to explain the role of ozone in the troposphere. These sentences were included to explain the contrast of the role of ozone in the troposphere with ozone's role in the stratosphere. This is an important distinction for the reader to understand. The sentence referenced in this comment does not convey the impression that ozone is the only substance that contributes to photochemical smog, within the context of the sentence.

Discussions of the environmental impacts of NO_x can be found in Sections 2.4.1, 5.1.1., 5.1.3, 6.1, and 8.1.1 of the PEIS.

1.46 Comment 46 [Air Quality]

p. 23, 3.1.1, last paragraph,
PM-2.5 is not discussed.

FAA Response 46:

The second sentence of the second paragraph of Section 3.1.1 has been modified to read

> *Maximum airborne concentrations are specified for the following criteria pollutants: ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter of 10 microns or less in diameter (PM_{10}), particulate matter of 2.5 microns or less in diameter ($PM_{2.5}$), and lead (Pb). The standard for $PM_{2.5}$ was proposed by the EPA; however, implementation was suspended by the United States Court of Appeals*[i].

The fifth and sixth sentences of the second paragraph were also modified to read: "Exceedences of these concentrations are determined over particular averaging periods (e.g., one-hour, 24-hours, annually). These averaging periods vary for different pollutants and several criteria pollutants have standards for more than one averaging period."

1.47 Comment 47 [Air Quality]

p. 24, Table 3-2,
The source for this table is not given. PM10 NAAQS primary standards do not match NAAQS on the EPA web site. Moreover, NAAQS standards are not listed for PM-2.5. While we realize that the NAAQS values for particulate matter have been "suspended" by the courts, we suggest that the preparers of this document include them in the context of best available information/regulation.

FAA Response 47:

In response to the comment regarding the lack of a source for the information in Table 3-2, the following footnote has been added to the table: "The information in this table was taken from the EPA website (http://www.epa.gov/airs/criteria.html)."

Table 3-2 has been modified to update the PM_{10} standards (150 $\mu g/m^3$ and 50$\mu g/m^3$ for the 24-hour and annual averaging periods, respectively) and to add the $PM_{2.5}$ standards (65 $\mu g/m^3$ and 15 $\mu g/m^3$ for the 24-hour and annual averaging periods, respectively). In addition, the following footnote has been added to the PEIS: "The U.S. Supreme Court recently (February 2001) unanimously upheld the constitutionality of the CAA as interpreted by EPA in the 1997 ambient air quality standards for ozone and particulate matter."

1.48 Comment 48 [Editorial]

p. 25, 3.1.2, 1st para,
This paragraph seems too technical for the lay person to understand. Fluorine should also be listed as it is an ozone-depleting chemical. Also, suggest changing the wording of the last

sentence from ". . .it functions as a major catalytic destroyer . . ." to ". . . it functions as a major catalyst for ozone destruction at those altitudes."

FAA Response 48:

While the FAA appreciates that this can be a confusing topic, it is FAA's opinion that the technical subject matter in Section 3.1.2 is described in a sufficiently readable format. Fluorine will be listed as an ozone depleting substance. The wording in the last sentence will be revised as suggested.

1.49 Comment 49 [Editorial]

p. 25, 3.1.2, 2nd para,
This para needs more information to be informative. Suggest preparers elaborate on the topics and tie their relevance together better, incorporate it into the previous paragraph (excepting the greenhouse gases discussion), or delete it altogether.

FAA Response 49:

This paragraph will be incorporated into the previous paragraph.

1.50 Comment 50 [Editorial]

p. 25, 3.1.4, 6th line down of 3rd para,
Suggest defining the word "monotonically" in lay person's terms or replacing it with the word "continuously."

FAA Response 50:

The word "monotonically" will be replaced with the word "continuously."

1.51 Comment 51 [Editorial]

p. 25, 3.1.4, last line of 3rd para,
Suggest using plain language to define interplanetary plasma, perhaps replace with the word "space."

FAA Response 51:

This change will be made in the final PEIS.

1.52 Comment 52 [Noise]

p. 26, 3.2, 2nd para, beginning with "dBA"
Should define dBm, SEL, and LAMAX. Also, the last sentence in this para is unnecessary since it is reiterated in the 4th para, beginning with Ldn.

FAA Response 52:

A definition for dBm will be incorporated into the document however, this paragraph does provide sufficient basic information about SEL (single event noise) and LAMAX (maximum A weighted sound level) without confusing the reader with too much technical detail about these two terms. The last sentence of this paragraph will be deleted as suggested by the commentor.

1.53 Comment 53 [Noise]

p. 27, Table 3-3,
Is there anything more recent than 1978?

FAA Response 53:

This table provides information about noise levels by comparing various decibels to common noise sources. This provides a framework for the reader to understand the relative impact of certain noises. The comparative measure of noise has not changed over time therefore the year of the study is irrelevant. The referenced EPA noise study is commonly referenced in NEPA documentation and provides a useful framework for the reader to understand comparative measures of noise.

1.54 Comment 54 [Editorial]

p. 30, 1st para, 3rd line, & 3rd para, 1st line
Suggest putting AIT in all caps as it is an acronym. Also, subsonic should be one word.

FAA Response 54:

The USAF uses a lower case acronym for the Atmospheric Interceptor Technology test vehicles that have been launched from Kodiak Island. The generally accepted acronym for atmospheric interceptor technology is lower case "ait." The dash has been deleted between "sub" and "sonic."

1.55 Comment 55 [Editorial]

p. 30, 1st para, 6th line,
Suggest putting phase focus boom and carpet boom in terms a lay person can understand.

FAA Response 55:

The following definition of carpet boom has been added to the document: "Shock waves produced by an aircraft traveling at supersonic speeds that cover the ground in a parabolic shape, resulting in a sound resembling a short, impulse noise, similar to a double gun shot." The following definition of focus boom has been added to the document: "A region of intense overpressure along the most uprange portion of the sonic boom footprint."

1.56 Comment 56 [Other]

p. 32, 3.3.1, Southeastern Atlantic Coastal Environment
No mention of hurricanes season for this environment where as it is mentioned in the section entitled, Mid-Atlantic Coastal Environment.

FAA Response 56:

The hurricane season extending primarily from August through October will be mentioned in section 3.3.1 of the document.

1.57 Comment 57 [Other]

p. 34, Sea Environment,
Some mention of how RCRA regulated hazardous wastes will be stored in this scenario should be added.

FAA Response 57:

Specific issues such as the storage of RCRA hazardous wastes will be addressed in site-specific environmental documentation generated for individual launches proposed from this environment type. A statement to this effect has been added to Section 1.3 and 5.3.2 of the Final PEIS.

1.58 Comment 58 [Other]

p. 34, last paragraph,
Please provide a reference for the every 3 to 5 years numbers.

FAA Response 58:

The following reference for the frequency of El Nino years has been added to the document: El Nino Southern Oscillation (ENSO) Primer 2 www.elnino/primer2.htm

1.59 Comment 59 [Editorial]

p. 36, Subarctic Pacific Environment, lines 5 & 6,
Need to put in terms a lay person could understand.

FAA Response 59:

While the FAA understands that this can be a confusing topic, it is FAA's opinion that these sections are written in such a way that they are readable and do not compromise the level of detail necessary to adequately describe this environment type.

1.60 Comment 60 [Editorial]

p. 37, 1st para, 3rd sentence,
Describe specifically what is meant by local iron and nitrate problems?

FAA Response 60:

The text has been revised to state: "There may be localized iron (from saltwater intrusion) and nitrate (from fertilizers, precipitation, and landfills) in shallow aquifers."

1.61 Comment 61 [Editorial]

p. 37, 1st para, 5th sentence,
Need to explain alluviating river in lay person's terms.

FAA Response 61:

The text has been modified to read: "A common floodplain (smooth valley floor adjacent to and formed by flowing rivers, which are subject to overflow) protection measure in this region is the construction of seawalls to protect the shoreline from erosion."

1.62 Comment 62 [Editorial]

p. 42, 3.3.5, last paragraph, 1st sentence,
Is: "In the East Coast . . ."
Should be: "On the East Coast . . ."

FAA Response 62:

This change will be made in the Final PEIS.

1.63 Comment 63 [Editorial]

p. 43, 4.1, 2nd para,
Is: "Commercial launch sites will prepare . . ."
Should be: "Commercial launch sites are required to prepare . . ."

FAA Response 63:

The referenced sentence has been modified to read

> *U.S. licensed launch site operators are subject to the FAA's licensing and safety regulations. Licensed launch sites co-located with federal launch ranges are subject to the FAA's licensing and safety criteria; however, these facilities may adopt existing federal range requirements if they are found to meet the FAA regulations.*

1.64 Comment 64 [Safety]

p. 46, 4.3,
Suggest addition of a liquid fuel spill on the pad as an accident scenario. Also, it should be mentioned that both a safety clear zone and a blast danger zone are established by Range Safety prior to each launch. Additionally, local environments are not discussed in Section 3.3, only regional environments. Please modify the text or include a discussion of local environments in other Section 3.3 [sic.].

FAA Response 64:

The suggestion of adding a liquid fuel spill on the pad has been noted but was not added to the PEIS. As stated in Section 4.3 of the PEIS, "The scope of this PEIS begins with

ignition of an LVs propulsion system." Therefore, examining an on-pad liquid spill scenario is outside the scope of this PEIS.

A statement to the effect that a safety clear zone and blast danger zone are established by Range Safety will be added to the document as this is true for all launches. In addition, FAA is proposing the following requirements for flight hazard areas which will be included in the Final PEIS:

> *regions of land, sea, and air that are exposed to the potential adverse effects of planned and unplanned launch vehicle flight events and that must be monitored, controlled, or evacuated in order to ensure public safety. The flight hazard area requirements apply to orbital and ballistic launch vehicles that use a flight termination system to protect the public.*

Local environmental impacts must be addressed in site-specific environmental documentation and considered on a case-by-case basis as local environmental conditions vary significantly from site to site.

1.65 Comment 65 [Safety]

p. 47, 4.4, 1st para, 6th line from the bottom of para,
Suggest preparers consult the Jan 97 Delta II accident report. Solid propellant fragments did continue to burn after the casings were ruptured. The solids, once lit, will continue to burn until the propellant is spent or it is separated from burning solid propellant. CCAS Range Safety personnel have found solid stages that have continued to burn underwater.

FAA Response 65:

Although there are isolated instances where solids have continued to burn after the casings were ruptured, these incidents are relatively uncommon. The PEIS recognizes this fact and states: "Although propellant pieces might continue to burn until impact, ***most*** solid propellants do not continue burning when the propellant grain is broken and no longer under pressure." (emphasis added)

1.66 Comment 66 [Air Quality and Propellants]

p. 49, 5.1.1, para under Table 5-1;
It should be noted that NOx is created any time something is burned in air, including when a person uses a domestic stove. Additionally, the Titan IIG uses hypergolic fuels.

FAA Response 66:

The text has been modified to include the following: "Not all of these substances are produced by all of the various propellant systems. HCl and Al_2O_3 will be discussed below. NO_x is an ozone depleting substance that is produced by all propellant systems with the exception of the cryogenics (LO_x/LH_2)."

1.67 Comment 67 [Air Quality]

p. 50, 2nd para under Table 5-2, second line,
It should be noted that even though the Delta II 7920H is not considered a large LV, its cloud is predicted to stabilize at 1344 m by REEDM analysis. Suggest revising this statement to include medium and intermediate LVs.

FAA Response 67:

The second sentence in the second paragraph under table 5-2 has been revised to read: "For some medium and larger launch vehicles, this cloud may rise to 1 km or more before stabilizing."

1.68 Comment 68 [Air Quality]

p. 51, 1st para, line 7,
Specific HCl concentrations are mentioned for Vandenberg launches. Concentrations of pollutants of concern should be mentioned for all sites (i.e., Vandenberg, CCAS, Goddard, and Kodiak)

FAA Response 68:

This document is written to be programmatic in nature. HCl concentrations were provided using REEDM model runs for various launch vehicles of differing sizes to provide a context to the reader of what ranges of HCl one might expect given different sizes and types of SRMs. A discussion of specific locations is not appropriate for this type of analysis. That the data sources were all for launches from Vandenberg is immaterial.

1.69 Comment 69 [Editorial]

p. 51, 1st para, last line
Last line should be moved up

FAA Response 69:

This change will be made in the final version of the PEIS.

1.70 Comment 70 [Editorial]

p. 51, 2nd para, first line
An explanation of what is meant by conservative should be provided (e.g., protective of resources).

FAA Response 70:

This sentence was revised to read "…a conservative (resource protective) estimate of programmatic launch…"

1.71 Comment 71 [Air Quality]

p. 51, last para
PM2.5 limits should be listed in previous sections if regulated by the EPA. Please check your assumptions with regard to PM10. Greater than 50% of particulate matter emitted by the Delta II GEMs are ≤ 10 microns. Although PM10 regulations have been suspended – EPA has appealed the ruling.

FAA Response 71:

The second sentence of the first paragraph in the Aluminum Oxide section has been revised to read: "EPA has recently proposed revised standards for particulate matter equal to or less than 10 microns and additional more stringent standards for particulate matter equal or less than 2.5 microns in size. Some portion of particulate matter from launch vehicle emissions could be equal to or less than 2.5 microns in size. For example, greater than 50 percent of particulate matter emitted by the Delta II graphite epoxy motors (GEMs) are less than or equal to 10 microns."

1.72 Comment 72 [Air Quality]

p. 52, 1st para
REEDM does not model PM10. Particulate matter modeled in REEDM ranges from 115 – 870 microns. The standards for PM10 in this paragraph should be used for the previous tabulated NAAQS values. The previous paragraph mentions PM2.5 as the only regulated particle size.

FAA Response 72:

Page 74 has been revised to include a discussion of REEDM modeling the text of which is attached below. "One modeling analysis used REEDM to estimate concentrations of particulate matter (115-870 microns in size) for a Titan IV-Type 2 launch vehicle. The analysis estimated that particulate matter concentrations for 24-hours were 25 $\mu g/m^3$ above background PM_{10} concentrations.[2]"

The NAAQS values for PM_{10} have been updated in the PEIS and values for $PM_{2.5}$ have been added to the PEIS.

1.73 Comment 73 [Editorial]

p. 52, 5.1.2, 3rd para, last sentence
LVs do not produce sulfur gas. Suggest deletion of last sentence to avoid confusion.

FAA Response 73:

This statement will be removed from the document.

[2] Department of the Air Force. Environmental Assessment Titan IV/Solid Rocket Motor Upgrade Program, Cape Canaveral Air Force Station, FL, Vandenberg Air Force Base, CA. February 1990.

1.74 Comment 74 [Editorial]

p. 52, 5.1.2, 4th and 5th, para
In the fourth paragraph the verb form is "may" whereas the fifth paragraph uses "will" referring to CO2 emission effects on global warming. Suggest conditional language throughout.

FAA Response 74:

This change will be made in the Final PEIS.

1.75 Comment 75 [Air Quality]

p. 53, 3rd para
Bromine is mentioned as an ozone destroyer, however, it is not a constituent of LV propellants or LV emissions.

FAA Response 75:

All references to bromine will be removed from the PEIS.

1.76 Comment 76 [Air Quality]

p. 53, 4th para,
Delineate difference between "Emissions from rocket engines," and (emissions from) "commercial LV launches." Need to define photolyzed in laypersons terms. Suggest modifying last two sentences to read, "Before HCl can deplete ozone, the chlorine has to be separated from the hydrogen. Some of the HCl gets mixed into the troposphere and rained out before the separation occurs. Therefore, it does not have a chance to destroy ozone." Also, it should be noted that the studies have shown the percent reduction of ozone per ton of HCl is 2.8 x10-5, 7.5 x 10-6 for Al2O3, and 1.6 x10-6 for NO per: 1) Jackman, C. H., D. B. Considine, and E. L. Fleming, *A global modeling study of solid rocket aluminum oxide emission effects on stratospheric ozone*, Geophys. Res. Lett., 25, 907-910, 1998. 2) Jackman, C. H., E. L. Fleming, S. Chandra, D. B. Considine, and J. E. Rosenfield, *Past, present, and future modeled ozone trends with comparisons to observed trends*, J. Geophys. Res., 101, 28, 753-28, 767, 1996. 3) Vitt, F. M., and C. H. Jackman, *A comparison of sources of odd nitrogen production from 1974 through 1993 in the Earth's middle atmosphere as calculated using a two-dimensional model*, J. Geophys. Res., 101, 6729-6739, 1996.

FAA Response 76:

The statement referenced by the commentor intends to point out that emissions from licensed LV engines are a subset of all launch vehicle emissions.

The final two sentences of the fourth paragraph on page 53 were replaced with the following text: "Before Cl can deplete ozone, the HCl must be photolyzed (i.e., light must interact with the HCl molecule and release Cl) and the resulting Cl can then deplete ozone. Some of the HCl in the troposphere can mix with water and be rained out of the atmosphere before it has a chance to release Cl, thus reducing some destruction of ozone by Cl."

The following sentence was added to the PEIS after the second sentence in the third complete paragraph on page 53: "For example, studies have shown the percent reduction of ozone per ton of HCl is 2.8 $x10^{-5}$, 7.5 x 10^{-6} for Al_2O_3, and 1.6 $x10^{-6}$ for NO." The following references will be added for these values: "1) Jackman, C. H., D. B. Considine, and E. L. Fleming, *A global modeling study of solid rocket aluminum oxide emission effects on stratospheric ozone*, Geophys. Res. Lett., 25, 907-910, 1998. 2) Jackman, C. H., E. L. Fleming, S. Chandra, D. B. Considine, and J. E. Rosenfield, *Past, present, and future modeled ozone trends with comparisons to observed trends*, J. Geophys. Res., 101, 28, 753-28, 767, 1996. 3) Vitt, F. M., and C. H. Jackman, *A comparison of sources of odd nitrogen production from 1974 through 1993 in the Earth's middle atmosphere as calculated using a two-dimensional model*, J. Geophys. Res., 101, 6729-6739, 1996."

1.77 Comment 77 [Editorial]

p. 53, 5th para, 2nd and 3rd sentence
Need to replace these sentences with the fifth and sixth sentences of the third paragraph on page 75

FAA Response 77:

This change will be made in the final version of the PEIS.

1.78 Comment 78 [Air Quality]

p. 54, 2nd para, line 8
Suggest definition/explanation/deletion of Rayleigh scattering. If the Rayleigh scattering aerosol to which you refer is HCl that should be specifically mentioned.

FAA Response 78:

The fourth sentence of the first complete paragraph on page 54 has been replaced with the following: "Ground-based light detection and ranging equipment results from this study have indicated that (1) the relative rates of plume expansion and diffusion are quite different than previously assumed; (2) stratospheric plumes stratify into stable layers of only several hundred meters thick; and (3) large SRM aerosol emissions consist of alumina and an additional aerosol that disappear within 90 minutes of launch and do not appear in plumes above approximately 35 km."

1.79 Comment 79 [Cumulative Impacts]

p. 54, 2nd para, last sentence
An increase in UV near launch sites would not be anticipated due to dispersion of exhaust gases. There is a potential, however, for UV increases globally, which should be mentioned.

FAA Response 79:

Please refer to the response to comment 22.

1.80 Comment 80 [Editorial]

p. 54, 3rd para
Cite reference for quantities listed

FAA Response 80:

The reference for the quantities is as follows: "World Meteorological Organization. Scientific Assessment of Ozone Depletion: 1994. Report No. 37. February 1995."

1.81 Comment 81 [Air Quality]

p. 54, last para
Yearly range inconsistent with Section 2 (1998-2009). Describe smallest size mode used in RISO study. State what launch vehicle is assumed for particulate matter sizes in RISO. See comment number 78 and 79.

FAA Response 81:

This section will be modified in the final version of the document to be consistent with the data presented in Section 2 of the document.

1.82 Comment 82 [Editorial]

p. 55, 3rd para, next to last sentence,
State the reference for this statement.

FAA Response 82:

The following reference has been added to the PEIS: "Ross, Martin. Rocket Impacts on Stratospheric Ozone Interim Report. Environmental Protection Agency Stratospheric Protection Division. June 27, 1997."

1.83 Comment 83 [Editorial]

p. 56, 2nd para, 4th sentence,
Include reference/substantiation for the claim that HCl would be washed out near the launch site rather than further from the pad.

FAA Response 83:

FAA believes that this claim is substantiated by the following reference: McDonald, Allan J, and Robert R. Bennett. Atmospheric Environmental Implications of Propulsion Systems. Brigham City: Thiokol Space Operations, August 1994.

1.84 Comment 84 [Air Quality]

p. 56, 2nd para, last sentence,
It should be noted that Al2O3 emissions would occur in particle form for the solid propellant that burns, which could be a significant portion.

FAA Response 84:

This referenced statement has been revised to read "The Al_2O_3 emissions would primarily occur in particle form from the burned solid propellant."

1.85 Comment 85 [Editorial]

p. 57, 5.1.5,
It is thought that this Section/analysis is too detailed for the stated level of concern over the potential impact (see last paragraph on p 58).

FAA Response 85:

FAA believes that this amount of analysis is appropriate given potential concerns of the impacts of emissions from vehicles used for licensed launches on the atmosphere.

1.86 Comment 86 [Editorial]

p. 59, 5.2.1, 3rd para, 2nd sentence,
Is: "To put these concerns into prospective, . . ."
Should be: "To put these concerns into perspective, . . ."

FAA Response 86:

This comment will be addressed in the Final PEIS.

1.87 Comment 87 [Wildlife]

p. 61, 5.2.2, 2nd para, 7th through last sentence,
Please state the extent to which egg damage been studied and recorded. If counts were performed just before and after each launch it should be so stated. Reference 134 refers to Kodiak, not Shuttle or Titan. Suggest using original reference.

FAA Response 87:

The following sentence will be removed from the final version of the Draft PEIS "Little egg damage has been recorded." In addition, the following reference will be modified to replace the current reference 134 "U.S. Air Force, Environmental Assessment for the California Spaceport; Vandenberg Air Force Base, CA 30SW/ET Vandenberg Air Force Base, CA December 1994. As referenced in Brown & Root Environmental. Environmental Assessment of the Kodiak Launch Complex. Aiken: Brown & Root Environmental, June 1996."

1.88 Comment 88 [Editorial]

p. 63,
Suggest combining the page with the previous page

FAA Response 88:

FAA believes that this format allows readers to refer to impacts on specific receptors of launch related noises.

1.89 Comment 89 [Wildlife]

p. 70,
Suggest specific mention of threatened or endangered species in the regions or locales.

FAA Response 89:

The U.S. Fish and Wildlife Service's list of threatened or endangered species is constantly being revised and modified as species are added and removed from the list. This programmatic document is intended to serve as a general environmental document that would remain useful over time. As such, it would be inappropriate to address issues as specific as threatened and endangered species located within designated regions or locales. Threatened and endangered species will be considered in site-specific environmental documentation as appropriate.

1.90 Comment 90 [Other]

p. 74, 6.1, 3rd para, 6th line,
It should be noted that some versions of the new EELVs don't require SRMs. Therefore, with the introduction of the EELVs the commercial LV demand might be capable of being met without the use of solids.

FAA Response 90:

The SEIS for the EELV program was written to accommodate the use of SRMs on both Lockheed-Martin and Boeing's launch vehicles. The SEIS describes the need of both companies to use SRMs on their launch vehicles to meet the commercial market demand. The original EELV FEIS dictated the use of solids on one of the vehicle configurations. A Record of Decision for the SEIS was signed on May 24, 2000 and it is unlikely that once operational the EELV program will not use solids. The decision on whether to use solids will be up to the discretion of the launch operators and the specific mission requirements.

1.91 Comment 91 [Other]

p. 74, 6.1, last sentence,
Multi-propellant LVs have been extensively analyzed by Range Safety at CCAS and VAFB using REEDM. Suggest preparers contact Range Safety offices at both sites for more information.

FAA Response 91:

FAA is familiar with many of the studies performed by CCAS and VAFB and will continue to find ways to include them in the PEIS. As additional information becomes available it will be included in the PEIS.

1.92 Comment 92 [Editorial]

p. 75, 3rd para, 2nd through 4th sentences,
Suggest modifying these sentences to read, "Before HCl can deplete ozone, the chlorine has to be separated from the hydrogen. Some of the HCl gets mixed into the troposphere and is rained out before the separation occurs. Therefore, it does not have a chance to destroy ozone."

FAA Response 92:

The following statement has been added to Section 6.1 of the Final PEIS "Before the HCl can deplete ozone, it must be released from its chemical bond to the hydrogen. This occurs by photolysis which is the breakdown of a molecule by light. Some of the HCl gets mixed into the troposphere and is rained out before the photolytic reaction occurs, therefore, reducing some destruction of ozone by Cl."

The following statement was added to Section 5.1.2 "Before Cl can deplete ozone, the HCl must be photolyzed (i.e., light must interact with the HCl molecule and release Cl) and the resulting Cl can then deplete ozone. Some of the HCl in the troposphere can mix with water and be rained out of the atmosphere before it has a chance to release Cl, thus reducing some destruction of ozone by Cl."

1.93 Comment 93 [Editorial]

p. 75, 4th para, lines 5 and 10,
Year ranges don't match.

FAA Response 93:

The version of the PEIS maintained by the FAA does not have any references to year ranges on page 75. Therefore, FAA is unable to respond specifically to this comment. However, all year ranges will be updated to reflect the most recent available data for the final version of the PEIS.

1.94 Comment 94 [Editorial]

p. 76, 6.2, 1st and 2nd sentence,
First sentence is confusing. This alternative undoubtedly does have noise impacts, so the caveat makes no sense.

FAA Response 94:

The first sentence of this paragraph will be modified to clarify that the more environmentally-friendly propellants alternative would have some noise impacts associated with it.

1.95 Comment 95 [Editorial]

p. 78, 7, 2nd para, last line,
Is: ". . . resulting in no net gain to the global environment."
Should be: ". . . resulting in no net decrease in the environmental impact to the global environment."

FAA Response 95:

This sentence will be modified as suggested.

1.96 Comment 96 [Launch Manifest]

p. 78 7.1, 2nd para,
Question whether foreign launch vehicles could increase the number of their launches on a 1 for 1 basis.

FAA Response 96:

There is little doubt that foreign launch operators could increase the number of their launches to compensate for the loss of U.S. licensed launches, which vary between 17 and 22 per year. For example, as part of the Soviet Union, Russia conducted as many as 100 launches per year and now conducts only 30 launches per year. Much of this unused infrastructure remains operational and is beginning to be used to launch commercial satellites. Also, Europe's Ariane launch vehicle could increase operations by as much as twofold if the market was available.

1.97 Comment 97 [Editorial]

P. 79, 7.5, 2nd sentence,
"launch sites" should read "launches"

FAA Response 97:

This comment will be incorporated into the document.

1.98 Comment 98 [Launch Manifest]

P. 79, 7.5, 3rd sentence from the bottom of para,
In suggesting that U.S. launch sites might go underutilized, one questions if the EELV SEIS has been consulted by the preparers.

FAA Response 98:

This statement has been deleted from Section 7.5.

1.99 Comment 99 [Editorial]

P. 79, 7.6 & 7.7
These sections should certainly read with a more conditional tense, using such verbs as "could" and "might," rather than "would."

FAA Response 99:

Grammatical tenses will be changed throughout the document to the conditional tense, where appropriate.

1.100 Comment 100 [Other]

P. 80, 7.6, 2nd para on page, last sentence,
Is: ". . . while the U.S. would lag behind, both economically and technologically."

Commercial LVs and communications are not all or even the largest part of the U.S. economy, nor is technology driven more by these areas than the computer industry and government space launches.

FAA Response 100:

This section refers to the impacts of the no action alternative and therefore, the U.S. would only lag behind economically and technologically in the launch market when compared to the international commercial launch community. These statements in Sections ES 4.3 and 7.6 have been revised to read "Thus, foreign economies could possibly be stimulated, while the U.S. would lag behind, both economically and technologically in this market."

1.101 Comment 101 [Editorial]

P. 86, 9.1, 4th bullet,
Needs to be written in plain language.

FAA Response 101:

This bullet has been modified to read: "Using a deflector sheet on the flame bucket."

1.102 Comment 102 [Editorial]

P. 86, 9.2, sentence and 1st bullet,
The mitigation measure listed in the first bullet is required by law, so the phrasing that it is a "possible action to mitigate" is misleading.

FAA Response 102:

This statement has been removed from Section 9.2 of the document and has been added to Section 9 as an example of actions required to be undertaken by the license applicant.

1.103 Comment 103 [Editorial]

P. 87, 9.3, 2nd bullet,
Launching in optimal weather and wind conditions would be very prohibitive, though certain measures are already taken to reduce potential impacts of ground cloud pollutants to surrounding sensitive receptors. It should be noted that optimal conditions would actually allow for maximum dispersion (reducing pollutant concentrations) rather than minimal dispersion.

FAA Response 103:

The referenced bullet has been revised to read "Launching in optimal weather and wind conditions to maximize the rate of dissipation of the ground cloud while minimizing the potential impacts to sensitive receptors."

1.104 Comment 104 [Cumulative Impacts]

P. 87, 9.3, 3rd bullet,
It should be mentioned that though buying credits from an under-producer might mitigate the proposed action, there would be no net decrease in the amount of air emissions per launch and the impact to the global commons would remain unchanged.

FAA Response 104:

While it is true that the impacts to the global commons would not be changed this section addresses mitigating impacts at a local level (i.e., licensed launch sites) and therefore an emissions banking program could be considered as a possible mitigation measure.

1.105 Comment 105 [Other]

P. 87, 9.5, 4th bullet,
Coordination with the state historic preservation offices, etc., is required by NEPA.

FAA Response 105:

Agreed. This section does not differentiate between required and voluntary actions undertaken by the action proponent. Where there are possible adverse effects to historic or cultural resources, consultation with historic preservation offices and local stakeholders has the potential to mitigate the adverse effects.

1.106 Comment 106 [Wildlife]

P. 88, 9.6, 1st and 4th bullets,
It should be noted that relocating endangered or threatened animals is very challenging and is not always successful.

FAA Response 106:

True. Before undertaking this type of mitigation strategy consultations would need to occur with USFWS and/or the U.S. National Marine Fisheries Service (NMFS) and implementation of this strategy would need to be carefully considered on a case-by-case basis.

1.107 Comment 107 [Wildlife]

P. 88, 9.6, 3rd bullet,
It should be noted that barriers would only be effective for T & E birds if the object is to limit predators.

FAA Response 107:

Any of the mitigation measures listed in the PEIS are intended to be considered in site-specific environmental documentation and would be implemented on a case-by-case basis as the situation dictated. If this particular strategy were not appropriate for a situation it would not be implemented and other suggested mitigation measures could be used.

1.108 Comment 108 [Other]

P. 88, 9.6, last bullet,
Also required by NEPA.

FAA Response 108:

This bullet has been revised to read: "Coordinating early in the proposed project with U.S. Fish and Wildlife, NMFS, and/or state wildlife officials regarding any concerns including: local activities and monitoring of sensitive species (e.g., conducting operations to avoid sensitive breeding, spawning, or weaning seasons)."

1.109 Comment 109 [Editorial]

P. 89, 10, 2nd para, 1st sentence
Suggest changing the verb form from "will" to "would." Also, suggest adding "Generally," to the beginning of this sentence.

FAA Response 109:

Changes involving use of the conditional tense will be considered throughout the document as appropriate. The word "Generally," will be added to the beginning of the sentence.

1.110 Comment 110 [Other]

p. 90, 11
Need discussion of potential impacts, including land use, i.e., land is no longer available for public use.

FAA Response 110:

The commitment of land resources is generally not considered to be irreversible or irretrievable commitment of resources because after decommissioning of a launch site it may be available for public use.

1.111 Comment 111 [Editorial]

P. 103, reference 119,
References X-33 Draft Tier I Environmental Assessment; should reference Final EIS for X-33.

FAA Response 111:

This reference will be updated throughout the document to reference the National Aeronautics and Space Administration. Final EIS for the X-33 Advanced Technology Demonstrator Vehicle Program. 1997.

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2.0SMC/AXFV USAF (Jerry Olen)

2.1 Comment 112 [Other]

Recommend addressing orbital and reentry debris impacts to be consistent with NEPA and the National Space Policy shouldn't your PEIS address orbital and debris: control of debris during normal operations, minimizing debris generated by accidental explosions, selection of safe flight profile and operational configuration and specifically postmission [sic.] disposal of space structures i.e., upper stages and spacecraft.

FAA Response 112:

FAA requires launch licensees to comply with all regulations regarding orbital debris. It should be noted that orbital debris has no impact on the human environment as defined by NEPA unless and until the debris enters Earth's atmosphere. As for addressing control of debris during normal operations and minimizing debris in an explosion situation these issues would need to be considered in launch specific documentation as they would depend on the individual launch vehicle proposed to be used. Disposal of launch debris would need to be considered on a case-by-case basis and would be different depending on whether expendable or reusable vehicles were being used from the site. General information regarding orbital debris has been added to Section 3.1.5 – Orbital Debris Reentering Earth's Atmosphere and 9.7 – Orbital Debris Mitigation. In addition, please refer to the response to Comment 6.

2.2 Comment 113 [Other]

Regarding postmission [sic.] disposal of space structures, your PEIS should address compliance with, "If a space structure is to be disposed of by re-entry into the earth's atmosphere, either the total debris casualty area for components and the structural fragments surviving re-entry will not exceed 8 m^2 or it will be confined to a broad ocean or essentially an unpopulated area."

FAA Response 113:

Each launch applicant will need to comply with all applicable regulations regarding the dispersal of launch related debris in order to obtain a launch license. The specific disposal methods and dispersal areas will be considered in the safety evaluation during the licensing process for each launch.

2.3 Comment 114 [Other]

Further more shouldn't your PEIS identify your own FAA Rule (21 June 99) that addresses space debris generation: "-Debris generation will not result from the conversion of energy sources into energy fragments the vehicle or its components. - Remove stored energy by depleting residual fuels and leaving the fuel line valves open, venting pressurized systems, leaving batteries in a permanent discharge state and removing any remaining sources of stored energy and/or equivalent procedures."

FAA Response 114:

Please refer to the response to comment 112.

The "space debris generation" language quoted by this commentor is found in 14 CFR 415.39, "Safety at the end of launch," one of FAA's Safety Review and Approval Regulations. This section sets forth what safety procedures and precautions a launch license applicant must be able to demonstrate for any proposed launch in order to obtain safety approval by the FAA. The FAA agrees that some of these procedures might also mitigate potential environmental consequences of space debris generation. The mitigation measure section of the PEIS will be revised as appropriate to include those safety procedures that might also have mitigating effects.

3.0 SMC/AXFV USAF Theodore Krawczyk

3.1 Comment 115 [Propellants]

While your Draft PEIS discourages quite strongly, solid rocket vehicles, it does mention them and in mentioning them shouldn't references be made to the perchlorates present in all solid rocket motors as another reason for liquid vehicle preference?

FAA Response 115:

The Draft PEIS is not biased towards or against any propellant system but rather seeks to analyze the impacts of each system and discuss any potential impacts associated with each system. Section 5.3.3 of the PEIS contains the following discussion about perchlorates: "Solid rocket propulsion systems containing substances, such as ammonium perchlorate, are designed to burn the propellant completely. However, it is possible that chunks of the ammonium perchlorate in a binder matrix (e.g., PBAN) could fall into water bodies as unburned segments. The toxicity of the ammonium perchlorate is based on its reactivity; ammonium perchlorate is a strong oxidizer and potentially explosive. As an anion it can act as a competitive inhibitor of biochemical reactions, such as iodine transport in the human thyroid. However, it is expected that the ammonium perchlorate in a binder would dissolve slowly in the water with only very local impacts to marine life. Small water bodies would be more adversely affected than large water bodies."

3.2 Comment 116 [Other]

A casual observation, playing the devils advocate, is that there appears to be a dichotomy between launch vehicle types on this and another up-coming environmental document. Doesn't this beg the larger question that a reconciliation of the differences may be needed? Different business philosophies, not withstanding, but doesn't cost, schedule, and performance impact liquid rockets launches unfavorably and have a negative effect on launching American?

FAA Response 116:

It is assumed that the "up-coming environmental document" to which you refer is the Supplemental EIS for the EELV program, to which FAA is a cooperating agency. It should be noted that FAA updates their launch manifest every year. Unexpected changes in the manifest may be due to set backs in new vehicle development programs, satellite market fluctuations, or launch vehicle failures. FAA uses its own proprietary model to make estimates for annual launch manifests. Other groups including the launch industry and USAF may have their own models to predict the number of future launches. It would be unreasonable to assume that each group's estimates would be the same.

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4.0 California Coastal Commission

4.1 Comment 117 [Other]

Thank you for the opportunity to comment on the above-referenced EIS. As you know, most of the commercial launch activities that occur on the California coast are launched from Vandenberg Air Force Base. Vandenberg's Environmental Management Department has been very cooperative in coordinating with the California Coastal Commission on issues relating to both governmental and commercial launches. In reviewing these launch activities, the Commission has raised concerns regarding potential impacts to public access to the shoreline, recreational use of the beach, marine mammals, endangered species, and air and water quality. The commission staff believes that as the frequency of commercial launches from Vandenberg increases, these impacts to these resources will also increase.

Although Vandenberg is federal land and, pursuant to federal law, is not within the coastal zone (16 USC § 1453(1)), the launch activities have the potential to affect land and water use and natural resources of the coastal zone. Specifically, these launch activities could potentially close public access to, at least, three public beaches, Ocean Beach, Jalama Beach, and Point Sal State Park. Additionally, the proposed project can potentially affect marine mammals and endangered species on Vandenberg and San Miguel Channel Island. Although both of these areas are federally owned, the species affected by launch noise, sonic booms, and air emissions from launch activities are resources of the coastal zone. Finally, launch activities have the potential to affect air and water quality resources, which are also the resources of the coastal zone.

FAA Response 117:

The PEIS is intended to consider potential environmental impacts on a broad scale at the programmatic level. Thus, the PEIS analyzed potential environmental impacts of licensing launches on a geographical basis, considering regional environmental settings, including potential impacts to coastal regions. Specific launch events will be examined under site specific environmental documentation. The potential environmental impacts associated with each type of launch vehicle from Vandenberg (or other sites) will be considered pursuant to NEPA requirements. Potential impacts to endangered species, marine mammals, air or water quality, as well as recreational land use will be considered under this type of environmental documentation. If impacts are found to be significant for any particular launch vehicle proposed to be launched from a specific site, additional analysis will be required.

4.2 Comment 118 [Other]

It is clear that the program described in your PEIS is for activities that affect coastal zone resources. The federal Coastal Zone Management Act (CZMA) requires that any federally permitted activity in or out of the coastal zone that affects land or water uses or natural resources of the coastal zone must be conducted in a manner consistent with the California Coastal Zone Management Program (CCMP). Pursuant to the requirements of the CZMA and its implementing regulations, the CCMP lists federal permits and licenses for activities that are likely to affect coastal resources. If an activity requires a federal permit or license that is listed in the CCMP, the federal agency cannot authorize the activity until the Commission concurs with a consistency certification. The license required for commercial space launch activities is not

listed in the CCMP. However, because of their potential affects on coastal resources, the Commission staff believes that these activities should be reviewed for consistency with the CCMP. This review can be accomplished through one or two processes. The commission can either review the federal register for notices of licenses for activities that have the potential to affect the California coastal zone and request permission to review each activity or we can amend our list to include the license from commercial space launch activities. In this case, the Commission staff believes that it is more efficient to amend the CCMP's list.

Therefore, the purpose of this letter is to notify your agency of our intent to list licenses for commercial space launch activities. The federal regulations implementing the CZMA require the Commission to consult with the responsible federal agency before amending its list (15 CFR § 930.53 (d)). This letter initiates the consultation process. Please respond within 30 days from receipt of this letter. If we do not hear from you, we will assume that you have no concerns about the addition of licenses for commercial space launch activities to the CCMP. If you believe that it is necessary, we will gladly meet with you either in person or through a conference call. If you have any questions, please contact James Raives of the Commission staff at (415) 904-5292 or email him at jraives@coastal.co.gov.

FAA Response 118:

FAA appreciates the time taken by the California Coastal Commission to review and provide comments on the PEIS. Representatives of FAA have contacted Mr. James Raives to further discuss the Commission's ideas about coastal zone management issues as they pertain to licensed launch events.

5.0 U.S. Department of the Interior

The U.S. Department of the Interior had no comments on the PEIS at this time. Please refer to Appendix B for the full text of the comment.

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6.0 U.S. Environmental Protection Agency

Cover letter: In accordance with our responsibilities under Section 309 of the Clean Air Act and the National Environmental Policy Act (NEPA), the Environmental Protection Agency (EPA) has reviewed the Commercial Space Transportation's Draft Programmatic Environmental Impact Statement (EIS) for Commercial Launch Vehicles.

The EIS assesses the environmental impacts of the proposed action of licensing commercial launch vehicles. The major categories addressed were atmospheric impacts, noise impacts, and other environmental impacts. Potential cumulative impacts and mitigation measures were also addressed.

EPA believes that the EIS is helpful in surveying the scope of potential environmental impacts from U.S. commercial space launch activity and cumulative atmospheric impacts of worldwide rocket launch activity. On the basis of our review, we have assigned a rating of LO (Lack of Objections) to the proposed action. We do have a number of suggested clarifications/corrections to the EIS text.

6.1 Comment 119 [Air Quality]

Page xiii, Section ES. 4.1: "Any local effects that might be associated with LVs, such as the extremely small potential for acid rain and stratospheric ozone depletion…" We suggest that this be reworded to say "Any local effects that might be associated with LVs, such as the considerable local/regional potential for acid rain, and highly transient and localized stratospheric ozone depletion…" The local acid rain impact seems substantial, although the contribution of rocket emissions to nationwide inventories of acid rain deposition may be small.

FAA Response 119:

The statement in the PEIS has been modified to read: "Any specific effects that might be associated with launches such as the potential for acid rain, and highly transient and localized stratospheric ozone depletion, would occur outside the U.S."

6.2 Comment 120 [Editorial]

Page 2, 3rd paragraph. We suggest that this section include additional discussion of "reusable launch vehicles," "reentry vehicles" and "launch vehicles", in order to provide a clear definition of the proposed action. We also recommend that this section discuss in more detail the time period covered by this EIS. Why is the 1998-2009 period used? Will a revised programmatic EIS be prepared to cover the period beyond 2009? If so, when will preparation of that document begin?

FAA Response 120:

Both Expendable and Reusable Launch Vehicles are defined on page 1 of the PEIS in a footnote. Please also refer to the response to Comment 27. The time period which was selected to bound the study of this PEIS will be modified in the Final PEIS to reflect more recent dates and the modifications in the number of launches based on FAA's predictive model.

6.3 Comment 121 [Editorial]

Page 3, first full paragraph. Suggest adding definitions of "programmatic" and "non-programmatic" to the Glossary (although explanation of these terms is provided on p. xiv, some readers may not have seen it).

FAA Response 121:

These definitions will be added to the glossary in the final version of the PEIS.

6.4 Comment 122 [Editorial]

Page 23, 3rd paragraph. "The major components of the troposphere are nitrogen (N_2O)…" this is the incorrect chemical formula. Also, in the following sentence, the formula for nitrous oxide is not NO – it is N_2O.

FAA Response 122:

These corrections will be made to the final version of the PEIS.

6.5 Comment 123 [Editorial]

Page 25, first paragraph. Add "of ozone" to the last phrase so it reads "…as a major catalytic destroyer of ozone at those altitudes."

FAA Response 123:

The sentence has been revised to read "…as a major catalyst for ozone destruction at those altitudes."

6.6 Comment 124 [Noise]

Page 26, 2nd paragraph. SEL of the sound exposure level and is a measure of the energy with a reference to a standard duration of 1 second. While SEL is a measure of a single event it is only the same as Lmax if the Lmax duration is one second. Lmax describes the loudest level of an event, but it does not describe how long it lasted.

FAA Response 124:

The text in this section has been modified to read: "LAMAX is another metric used to describe the maximum dBa noise level."

6.7 Comment 125 [Editorial]

Page 27. The dBA ranges at the top of the page should be referenced to either SEL or Lmax, as appropriate.

FAA Response 125:

The footnotes associated with the dBa readings reflect the information given in the references. Since these are mostly time averaged readings SEL and Lmax would not be specified.

ACADEMIC ORGANIZATIONS

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7.0 University of Southern California

7.1 Comment 126 [Safety]

Page 30, Paragraph titled Accidents should be re-written as follows: To establish a basis for water impact assessment, the sound level and the dominant frequency of the anticipated sonic boom noise at various depths (taking into consideration the strength and waveforms of the incident sonic boom wave, the prevailing sea states and the seafloor presence over and under the impact zone) must be compared with established data from bioacoustic studies critical to marine mammal conservation. There is very little information regarding noise levels in water after accidents and consequently deserve a brief passing comment as the basis for future investigation and analysis. The reason for this is because most of the efforts to date have been focused on launch accident noise. An explosion of a LV will produce significantly higher noise levels than those produced during normal operations.

FAA Response 126:

Text similar to the following has been added to the document: "There is very little information regarding noise levels during accidents, as most efforts to date have focused on launch noise. In particular, little research has been conducted on noise levels in the water during an accident. Underwater noise studies of accidents would need to consider the prevailing sea state and seafloor topography around the impact area, these data would be compared to established data from bioacoustic studies specific to marine animals. The primary focus of accident related noise studies has been on noise levels above the water. An explosion of an LV will produce significantly higher noise levels than those produced during normal operations. The U.S. Air Force predicted a noise level of 200 dBA and an overpressure of 4,000 psf at a distance of 100 feet for a Titan IV/Centaur vehicle. However, an exploding Titan IV should not be considered a typical scenario, because the Titan IV core vehicle uses hypergolic propellants. In a failure, hypergolic propellants deflagrate, instead of detonate, which produces less overpressure than an LV employing LO_x/RP1 or LO_x/LH_2. Thus, an accident involving a larger LV such as a Titan IV may produce less noise than a smaller LV, such as an Atlas or Delta.**"**

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INDUSTRY AND INDUSTRIAL ORGANIZATIONS

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8.0 Aerospace Corporation

8.1 Comment 127 [Editorial]

Please note that in your references, you use a lot of presentations and non referenced material generally, references should be published and available to the public, preferably in a referred/reviewed publication such as yours.

FAA Response 127:

Whenever possible the FAA has used and referenced publicly available, professionally reviewed reference material. However, due to the fact that this document attempts to use the most up-to-date information and includes recent material and studies, in some cases publicly available documents incorporating the materials are simply not yet available. If in the future any of the referenced studies are published and made available publicly, FAA will update the PEIS to reflect the availability of these documents.

8.2 Comment 128 [Editorial]

Pages 13-17. Fig. 2-1-2-5. Four of the figures show staging in terms of time and event only. Only Fig 2-3 is more useful for describing the effects on the atmosphere, because it gives altitude and down range distance. Suggest adding approximate altitude and down range distance to Fig 2-1, 2-2, 2-4, and 2-5.

FAA Response 128:

This comment has been noted; however, the operations of launch vehicles vary considerably and developing an estimation of altitude and down range distance would not be accurate for some launch vehicles within the designated payload capacity categories. This information would be required to be included in site and/or vehicle specific environmental documentation.

8.3 Comment 129 [Launch Manifest]

A comparison was made between launch rates of the prospective EELV SEIS and the FAA Draft and while the launch rates are comparable the mix between solids and liquids are different. The FAA Draft mix is 1/3 solids and 2/3 liquids while the EELV SEIS mix is the opposite and that ALL commercial medium vehicles would use solids (the 1/3 comprising the projected launch rate in there EIS consisting of liquid vehicles.) If not for continuity, the projection would have been all solid.

FAA Response 129:

For the FAA PEIS, medium launch vehicles include the Delta 2 class vehicles, which are liquid launch vehicles with solid strap-ons. U.S. small launch vehicles, defined as below 5,000 lb to LEO, currently use only solid propellants for their boost stages. The EELV program will not result in the phasing out of the Delta 2, so it will likely remain the dominant U.S. medium launch vehicle.

Please note that all launch figures will be updated in the final version of the PEIS. FAA anticipates that some of the launch forecasts may change in the final version due in part

to the EELV SEIS modifications to the two families of vehicles adding solids to their launch vehicles from the earlier EELV FEIS.

9.0 The Boeing Company

9.1 Comment 130 [Propellants]

Preferability of certain propellant system alternatives Section 2.4.1 (pp. 19-20) states LOX-RP1 and hybrid propellant systems are perceived to be more environmentally preferred than solid propellant systems based on the relative types and quantities of emissions dispersed throughout the atmosphere. The reader is then directed to Appendix A for data supporting this conclusion. While we agree with the general conclusion that the LOX-RP1 propellant system is favorable from an environmental point of view, the draft PEIS appears to stop short of providing justification for this fact in the main text or Appendix A. Given the important and ongoing focus on vehicle emissions, we believe it would be constructive if the PEIS more fully explained and documented the scientific rationale and supporting professional opinions that add weight to this conclusion.

FAA Response 130:

Studies have been conducted to determine the emission products from vehicles using solid and vehicles using liquid propellants. It is possible to know what the emission products are from each type of propellant system but it is not currently possible to compare the relative impacts of these propellant systems against each other. Therefore, it is not possible, given current research, to say with any degree of certainty which type of propellant system is most environmentally damaging. The current debate regarding whether solid propellant systems are more environmentally detrimental than liquids has not had conclusive evidence to support either solid or liquid systems as the most environmentally benign. Although, to date research has focused on the issues associated with emissions from SRMs, on-going research is indicating concerns with liquid systems that need to be further explored. FAA believes that the information provided in Appendix A of the PEIS and throughout the body of the text provides a basis from which to assess impacts. As additional studies are performed on this subject, FAA will incorporate this information into subsequent versions of the PEIS.

9.2 Comment 131 [Other]

International impacts and obligations. Chapter 1 defines the scope of the PEIS and FAA's authority under various statutes, with an emphasis on the NEPA process. Given the increasingly international character of the U.S. commercial launch industry, we suggest more emphasis be provided on international impacts and obligations in this and other sections of the document.

FAA Response 131:

This level of detail regarding international impacts and obligations would not be appropriate for this type of programmatic document. NEPA regulations are emphasized because they apply to the vast majority of U.S. companies intending to launch vehicles. All U.S. companies intending to launch from foreign launch sites will need to complete the licensing process for the FAA which includes completion of an environmental review. The launch operator would be responsible for determining relevant host country rules and regulations as well as international treaties that would apply to its specific situation and addressing them in site specific documentation.

9.3 Comment 132 [Other]

For, example, we believe the purpose and applicability of Executive Order 12114, Environmental Affects Abroad of Federal Actions, should be referenced or explained more prominently in Chapter 1. We also note the discussion on EO 12114 in Appendix C (pg. 158) appears, in our opinion, to have misstated the relationship between the EO and the NEPA statute. After re-reading EO 12114, we do not conclude the Order establishes FAA's "*right to require* NEPA in the case of launches that have the potential to significantly impact foreign States" (emphasis added). We believe it is always FAA's prerogative to apply the NEPA process in such cases. We believe, however, FAA should instead establish its right "to further the purpose of NEPA", but to also allow for the process used to be tailored case-by-case with each license applicant and the governments and interest groups in the region to best address the issues involved.

FAA Response 132:

The following text has been removed from the PEIS: "Section 2 (b) specifies that 'Major Federal actions significantly affecting the environment of a foreign nation not participating with the United States and not otherwise involved in the action' are actions included and covered by this Executive Order."

The following text has been added to the document: "Section 2-3 sets forth the categories of actions included in and covered by this Executive Order. These actions include: (a) major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the oceans or Antarctica); (b) major Federal actions significantly affecting the environment of a foreign nation not participating with the United States and not otherwise involved in the action; and (c) major Federal actions significantly affecting the environment of a foreign nation which provide to that nation a product or physical project 'which is strictly regulated by Federal law in the United States'."

"The Executive Order sums up the FAA's right to require NEPA compliance, including the consideration of potential environmental impacts, in the case of launch licensing actions that have the potential to significantly impact foreign States and/or the global commons."

9.4 Comment 133 [Other]

We also believe it would be appropriate to note in the PEIS (either Chapter 1 or Appendix C) how and to what extent different international treaties and agreements apply to launch events. For example, we believe the PEIS should document the fact that Marine Pollution dumping rules do not apply to expendable stages – as has now been established for past launches.

FAA Response 133:

Appendix C of Volume I of the PEIS includes a list and brief description of relevant treaties, protocols, and conventions including MARPOL. The description of MARPOL reads:

> *The United States is party to the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships of 1973 as Amended (MARPOL) and Annexes I, II, III, and IV to MARPOL. With respect to normal debris released*

by expendable launch vehicles after launch, such debris is not covered by MARPOL as this agreement applies to ships. After lift-off from the launch pad, vehicles and their payloads are not ships within the meaning of MARPOL.

Discharges of spent stages and residual kerosene are part of the normal operation of launch vehicles, regardless of whether the vehicles are launched from land or sea, and therefore, are not covered by the London Dumping Convention or other related agreements. In particular, they do not fall within the meaning of "dumping" as the term is defined in Article III, section 1 of the London Dumping Convention or Article 1 section 4 of the 1996 protocol.

To the best of FAA's knowledge the international community shares this view. The FAA understands that such normal operational launch vehicle discharges have not generally been viewed by countries as dumping within the London Dumping Convention, and that the International Maritime Organization Secretariat has received no country reports indicating that countries have subjected such operational discharges to the London Dumping Convention regime.

9.5 Comment 134 [Other]

General descriptions of the Sea Environment. It is of course, difficult to describe – both briefly and comprehensively in a document of this scope – the full variety of ocean environments that might serve as a sea-based launch location. As written, however, the data used to describe the "Sea Environment" in Chapters 3, 4, and 5 depict a generalized, composite ocean that collectively most closely resembles east-central Pacific equatorial waters. This raises a number of concerns and observations.

First this geographic focus may be construed as an FAA presumption or preference for sea-based launched from Pacific equatorial waters when, in fact, launch platform mobility allows for launches from virtually any marine location throughout the world. The title "Sea Environment" has been also called the "Sea-Launch Environment" in several places (we've noticed this on pages 30 and 65), which may also be seen as limiting the discussion to the environment currently used by Sea Launch Company (in the east-central Pacific equatorial ocean). We assume this was not FAA's intent.

FAA Response 134:

The environment description of this type of sea environment was not intended to show preference for any particular sea-based launch site but rather to provide a generalized example of a sea environment. Sea–based launchers (platform or otherwise) do possess the ability to use a launch point at virtually any position around the world's oceans but it should be noted that adjustment of any launch location would require approval from FAA. Therefore the impacts of a sea-based launch from bodies of water would need to be examined in detail in site specific environmental documentation. It was not FAA's desire, nor is it the intent of NEPA to perform new environmental studies in preparing

this programmatic document. NEPA encourages the use of existing environmental baseline data where applicable. This type of programmatic environmental documentation provides an example of documentation that would be required for site specific documentation, and generally characterize broad environment types.

9.6 Comment 135 [Other]

In addition, some confusion may occur if the descriptions of effects discussions are read too literally. In particular, the descriptions of Pacific equatorial waters, and of the Atlantic and Pacific oceans more generally, are very difficult to follow as they consolidate disparate data without retaining the data's spatial or temporal contexts. In the case of the equatorial Pacific, this is reinforced by Figures 3-3 and 3-4, which are not particularly illustrative due to graphic size/quality and some lack of correspondence with the text. (Figure 3-4 also does not appear to be referenced in the text.) Generalization of data extends to the impact discussions in Chapter 5, where general conclusions of non-significance are inferred from rather spotty data.

FAA Response 135:

FAA believes that these graphics enhance the reader's understanding of the complex meteorological events related to El Nino conditions. In addition, Figure 3-4 will be appropriately referenced in the text of the final PEIS. The graphics will be modified to the extent possible to make them more readable.

The data presented on the sea environment type are intended to be general. FAA believes that the level of detail provided for the sea environment is of equal value to the data presented for other environment types. As stated earlier in the response to comments, all launch license applicants will need to consider in detail potential impacts of their proposed action on the specific local environment. Therefore, the data are presented in the PEIS on the environment types to serve as general descriptions of potential launch environments and are not intended to be detailed presentations of possible launch environments.

9.7 Comment 136 [Other]

We believe the net effect of this approach may be to confuse or risk misinterpretation by readers and users of the PEIS. We suggest instead that these discussions could be restructured to: 1.) list the range of sea environments from which a sea-based launch could occur, and then 2.) include the present description, but edited as a geographically-specific example of a Sea Environment, i.e., east-central Pacific equatorial ocean. Consistent use of the term "Sea Environment" would further help to disassociate the text from Sea Launch Company's current launch location and downrange environment.

FAA Response 136:

Due to the fact that FAA's intent in writing the PEIS was to avoid specifically identifying launch locations or potential launch environments, the range of possible sea environments will not be specifically discussed in the PEIS. FAA will consider adding a footnote to the sea environment section to state that this environment type may be most similar to a Pacific launch environment. However, FAA believes that the local environments of other potential launch sites in deep sea locations are similar to those

described in the PEIS. FAA will replace any remaining references to "sea-launch environment" to "sea environment."

9.8 Comment 137 [Cumulative Impacts]

Section 8.3 (pg. 84) - Cumulative Impacts to Local Environments. We agree that it is beyond the scope of the PEIS to infer much about cumulative impacts to local environments. It may, however, be appropriate and useful to present the concept of cumulative impacts at a launch location being assessed, in part, in terms of time it takes environment-specific parameters to return to background levels after a launch, e.g., plume emissions and animal behavior. The extent to which this 'return-to-background' occurs before another launch occurs from that exact same location would, perhaps, be a useful gauge of cumulative impact to introduce the PEIS for use by individual applicants.

FAA Response 137:

This change has not been made in the Final PEIS.

9.9 Comment 138 [Editorial]

Proven viability of Sea-based Launch Vehicles. The paragraph on page 12, 'High Payload Capacity', should be revised to reflect the successful launches by Sea Launch Company from its sea-based platform, which became operational in early 1999. Similarly, Table 2-5 should be revised to show the High Capacity Sea Category as 'Existing Vehicles', and the title of Table 2-5 should be revised to read "Surface -Launched…"

FAA Response 138:

All launch numbers will be modified in the final version of the PEIS.

9.10 Comment 139 [Launch Manifest]

Projected Number of U.S. Launches in the High Capacity Category. Based on the weight categories in Table 2-1 (pg. 6), all Delta IV vehicles (i.e., M, M+, and H) fall into the High Capacity category. Our current mission model during the 1998-2009 time period includes 42 launches on Delta IV vehicles alone. Does the total number of U.S. launches for the high capacity category (88) include these Delta IV launches? Similarly, Table 2-6 (pg. 21) shows a total of 58 launches for the same time period in the High Capacity category. As noted above, 42 Delta IV launches are planned for this period that would fit into the "More Environmentally-Friendly Propellant Combinations" alternative. The number of projected launches seems somewhat low in this case as well.

FAA Response 139:

The percentages of medium, intermediate, and high capacity launches in the manifest were based on the May 1998 COMSTAC report. The trend toward heavier payloads was noted in the 1999 COMSTAC forecast, which reflected a higher percentage of heavy satellites being launched. However, this report had not been published when these data were compiled. The Final PEIS will include modified launch manifest numbers.

9.11 Comment 140 [Other]

Figure 2-5 (pg. 17) - Typical Flight Profile for a High Capacity LV key data in the figure's table differ markedly from the typical flight profile in our experience. For example, the typical Delta IV launch vehicle profile is:

Time (Min:Sec)	Event
0:00	Liftoff, Stage 1 ignition, SRM ignition
1:40	SRM Separation
3:20	Fairing Separation
4:05	Stage 1 Cut-Off
4:11	Stage ½ Separation, Stage 2 Ignition
18:26	Stage 2 Shutdown
45:00	Stage 2 Restart
47:40	Stage 2 Shutdown
48:10	Orbital Insertion
>48:10	Payload Separation

These data lead us to conclude the times given, especially for the latter events, may be inaccurate.

FAA Response 140:

These time tables were developed based on a "typical" mission scenario for a launch vehicle in this category and were not intended to be specific to the Delta IV. The figures provided in the PEIS most closely resemble the Titan III and IV which were the highest capacity launch vehicle data available at the date of publish of this PEIS. The table in Figure 2-5 has been modified to read:

Time (Min:Sec)	Event
00:00	Stage 0 ignition (SRMs)
01:48	Stage I Ignition/SRM Jettison
04:30	Stage II Ignition/Stage I Separation
04:40	Payload Fairing Jettison
08:14	Stage II Shutdown
08:30	Orbital Insertion
08:30+	Payload Separation

9.12 Comment 141 [Other]

Marine Mammal Strike Probability Assessment. Marine mammal strike probabilities appear to be excessively conservative, and we suggest this is due, in part, to some unrealistic or incomplete assumptions. Briefly, we believe the assumptions used in Appendix B should be clarified or revised to better reflect scientific data and launch industry experience.

FAA Response 141:

FAA believes that this Appendix contains sufficient data to provide generic information about marine animal strike probabilities. These estimates can be modified based on site specific studies of migratory marine animals in the waters under flight paths. FAA believes that the data presented in Appendix B are appropriately conservative and provide a sufficient starting point for more detailed site-specific analyses.

9.13 Comment 142 [Other]

Most specifically, and as stated under Methodology (pg. 132), "…it is assumed that all the animals are at risk from any one component." This assumption, that representatives of all species are in one place at one time, is overly simplistic and incomprehensible from a scientific point of view. Unfortunately, this approach, coupled with the averaging of species densities throughout the Oceans (without reflecting at all the known lateral or vertical distributions of these animals), renders the final result misleading. As a result, the analysis considerably overstates the likelihood that a marine animal will be struck.

FAA Response 142:

Please refer to the response to Comment 141.

9.14 Comment 143 [Other]

In addition, the first paragraph on page 132 states that all stages impact the surface intact. This is, of course, contrary to industry experience - except in the case of launch failures occurring early in the ascent trajectory. For example, Sea Launch analyses by our vehicle designers show that while Stage I will typically fall intact, Stage II will break up into more than 25 pieces averaging several square meters in size and many smaller pieces, and Stage III will break up into more than 20 pieces.

FAA Response 143:

FAA is aware of the predictions developed by the designers of the Zenit 3-SL. This information was noted in the Final EA for the Sea Launch Project. The PEIS is intended to address general launch vehicles and is not intended to be specific to any one launch vehicle. Break up models of specific launch vehicles would be addressed in mission safety reviews prepared for the FAA and could be included as necessary in environmental documentation. This PEIS was intended to examine the worst case environmental break up scenario in which all stages impact the surface intact. From an environmental standpoint this is considered the worst case break up scenario because there is a high probability that the non-inert material will explode resulting in impacts to the air and the surface of the deposition area.

9.15 Comment 144 [Editorial]

Also in regards to the in-tact stage assumption made to "…total number of components of each stage or fairing…" (see Methodologies para. 1, pg. 132) appears to misuse the term "component", although we suggest recalculating debris impact probabilities assuming that the stages break up during descent. Similarly, use of the term "component" is confusing in Table B-2 and B-3 (a column labeled "one component", which may be better labeled "single flight"), and Tables B-4 and B-5.

FAA Response 144:

This change has not been made in the Final PEIS.

9.16 Comment 145 [Other]

The associated debris impact area assumptions (Table B-1, pg. 134) also contribute somewhat to the conservative result of the marine mammal impact analysis. A comparison of the PEIS model and the Sea Launch 3-SL launch vehicle gives the following values (sq. km).

LV	Stage I	Stage II	Stage III	PLF
PEIS	1.802E-03	3.119E-4	3.530E-05	5.294E-04
3-SL	N/A	1.12E-04	4.65E-05	2.54E-05

As shown, Stage III data are comparable, while Stage II (PEIS) is over 200% higher than for the 3-SL, and the PLF (PEIS) is an order of magnitude higher than that for the 3-SL.

FAA Response 145:

The marine animal strike probabilities and potential debris impact areas used in the calculations for Appendix B are intended to be general enough to address all LVs and are not intended to be specific to the Zenit 3 SL.

9.17 Comment 146 [Editorial]

We also suggest you revise the first column headings of Tables B-1 and B-2 to read "Marine Animals" (which was no doubt intended), to reflect the fact that turtles are reptiles, not marine mammals. And lastly, the calculations in Table B-1 and Tables B-2 and B-3 appear to mix units for debris areas, e.g., Table B-1 assumes a Stage III debris area of 3.53E-05 *km* for heavy lift LV, while Tables B-2 and B-3 use 3.53E-05 *sq. km.*

FAA Response 146:

These corrections will be made in the final version of the PEIS.

9.18 Comment 147 [Editorial]

Page 45: Figure 4-3 is out of date. We are enclosing an updated graphic for the Delta family of vehicles.

FAA Response 147:

The new graphic will be imported into the final version of the PEIS.

9.19 Comment 148 [Safety]

Page 46/47: Section 4.4, Accident During Vehicle Ascent, does not reflect the Sea Launch Integrated Launch Vehicle's autonomous on-board termination capability.

FAA Response 148:

Although, the PEIS is not intended to discuss specific launch vehicles or their components the following paragraphs have been added to the PEIS to further explain flight safety systems.

The FAA defines a flight safety system (FSS) as a system that provides a means of preventing a launch vehicle and its hazards, including any payload hazards, from reaching any populated or other protected area in the event of a launch vehicle failure. A FSS, unless otherwise approved in the course of the licensing process, consists of an onboard vehicle flight termination system (FTS), a command control system, and support systems on the ground, including tracking, telemetry, display, and communications, and includes all associated hardware and software. A FSS also includes the functions of any personnel who operate FSS hardware and software.

Federal launch ranges typically require an FTS on guided launch vehicles that have a capability to violate established safety criteria under powered flight, in order to protect the public and range personnel. For ELVs equipped with an FTS command flight termination capability, if a vehicle's IIP crosses a destruct line, the FTS is activated to destroy the vehicle. The reliability of the FSS plays more of a role than the reliability of the launch vehicle in achieving safety. The FAA seeks to maintain the same high level of safety that the federal ranges have achieved. At the same time, the FAA recognizes that more than one method exists by which to protect the public and achieve the requisite levels of safety.

An autonomous system uses a computer to evaluate vehicle status as well as vehicle performance to determine if a flight termination command is required. The U.S. standards require a flight termination system to destroy a vehicle, not just terminate the motor thrusts as is accomplished by a thrust termination system. An U.S. flight termination system is designed to terminate the thrust of the vehicle and to disperse the propellants with minimal explosive effect.

In addition, the following changes have been made to the document.

Section 4.4 first paragraph: "This accident scenario will… (e.g., as is used by an autonomous system that is …"

Section 4.4 fifth paragraph: "If telemetry or on-board systems show a launch vehicle heading outside…"

Section 4.4 fifth paragraph: "For ELVs equipped with a command flight termination capability, if a vehicle's IIP crosses a destruct line, the FTS is activated to destroy the vehicle."

Section 4.4 seventh paragraph: "Under these accident scenarios, the activation (either by autonomous or mission controlled transmissions) of the flight safety systems …"

9.20 Comment 149 [Other]

Page 47: The second paragraph, second sentence, should be revised to read "Thrust termination systems are used for both sea and land-launched ELVs."

FAA Response 149:

The second paragraph, second sentence has been revised to read "TTS systems may be used for both ocean and land-launched ELVs."

9.21 Comment 150 [Air Quality]

Page 115: In Table A-4, data for the Delta IV M+ vehicle (with four SRMs) should show approximately 119,225 kg of solid propellant burned in the troposphere and stratosphere. Using the formula provided with the table, calculated HCl would be 25,037 kg. Data given in the Draft SEIS for EELV shows a total of 17,273 kg of all chlorine compounds (HCl, Cl_2, Cl, and ClO) emitted in the troposphere and stratosphere.

FAA Response 150:

The data for the Delta IV M+ will be updated to reflect the figures provided by the commentor.

9.22 Comment 151 [Wildlife]

Page 38/39: We recommend that Section 3.3.4, "Local Biological Resources", be expanded to include table information on threatened and endangered species for each region.

FAA Response 151:

This document is intended to be programmatic in nature and to serve as accurate baseline data over time. The endangered species list is a dynamic list which is modified to reflect changes in species populations at any particular time. This list is subject to change as species are listed and de-listed over time, therefore FAA does not feel that it would be appropriate to include this information in this type of programmatic document. Instead, FAA will encourage license applicants to coordinate with USFWS and/or NMFS throughout the site specific environmental documentation process as necessary to determine potential threatened or endangered species present at the proposed site.

9.23 Comment 152 [Air Quality]

Page 51: In Section 5.1.1, "Troposphere", third paragraph, a discussion on acid rain states that modeling has estimated the impact for high payload capacity vehicle launches to occur over a distance of more than 200 km from the launch pad. This model result seems to be extremely conservative, since actual data show a maximum distance of only 16 km for acid rain deposition resulting from a launch (Reference FEIS for EELV, Section 4.1.14.1.2.1). Additionally, although the EELV has a higher payload capacity than existing vehicles, it should have significantly less acid rain deposition due to the lack of deluge water during launch.

FAA Response 152:

The following phrase will be inserted prior to the last sentence in the second complete paragraph on page 51: "A more recent study using REEDM for several different LV systems showed that surface waters at both Cape Canaveral Air Station and Vandenberg Air Force Base have ample alkalinity to neutralize the maximum acid deposition. Furthermore, this study showed that the impacts of LV emissions drop off significantly (>50 percent) at approximately 1 km from the launch site."

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10.0 Experimental Rocket Propulsion Society

10.1 Comment 153 [Editorial]

Page 16. Figure 2-4 shows a second stage burn of 17:13. That's much longer than any other burn. Is this correct?

FAA Response 153:

The second engine burn time for this generically sized vehicle is correct. However, please note that for the sake of simplicity, the graphic of the flight sequence does not include a possible stage two engine shut down and subsequent re-start which could occur during this time. A footnote has been added to the graphic which reads: "Note: the graphic of the flight sequence does not include a possible stage two engine shut down and subsequent re-start which could occur during this stage of flight."

10.2 Comment 154 [Editorial]

Page 20, line 10. "LOX-RPI" should be "LOX-RP1"

FAA Response 154:

This change will be made in the final version of the PEIS.

10.3 Comment 155 [Noise]

Page 30, 3rd paragraph. Math is badly wrong. If a 160 dBA noise level is attenuated 10%, it will measure 90% of 160 dBA, or ~159.95 dBA. If a 160 dBA noise level is attenuated to 10%, it will measure 150 dBA. To attenuate a noise level from 160 dBA to 16 dBA, it would have to attenuated 99.9999999999996%.

FAA Response 155:

This statement was deleted from the document.

10.4 Comment 156 [Other]

Page 43, "high mission success rates;" Atlas record of 232 for 267 in 1958-1994 (86.9%) is used as example. I don't see that as particularly high. We're going to have to do a whole lot better than that to get a decent share of the transport market.

FAA Response 156:

This comment has been noted.

10.5 Comment 157 [Air Quality]

Page 43, current study on Rocket Impact on Stratospheric Ozone (RISO) has confirmed that ozone depletion related to LV emissions is "temporary and limited." Initial results indicate that LO_x/kerosene engines may be "more potent in ozone depletion than previously expected." PEIS does not mention a proposed mechanism for ozone depletion in the absence of halogens and metals, nor does it give numbers for either previous or current expectations.

FAA Response 157:

The second sentence in the third complete paragraph on page 54 will be replaced with the following: "Analyses in the RISO study have confirmed that ozone loss occurs in the plume wakes of large SRMs (e.g., Titan IV and Space Shuttle), but the amount and duration of the loss appears to be temporary and limited."

10.6 Comment 158 [Editorial]

Page 74, LOX-RPI should be LOX-RP1.

FAA Response 158:

This change will be made in the final version of the PEIS.

10.7 Comment 159 [Editorial]

Page 84, line 7 chlorine is abbreviated CL vs. Cl

FAA Response 159:

This change will be made in the final version of the PEIS.

10.8 Comment 160 [Noise]

Page 86. Noise mitigation. AST actually suggests reducing power at liftoff.

FAA Response 160:

The mitigation section of the PEIS provides possible mitigation measures that could be employed if necessary to reduce the impact of licensed launch operations on the natural and human environment. All mitigation measures would need to be evaluated on a site specific basis.

10.9 Comment 161 [Editorial]

Appendix A contains a blank page between table A-10 and table A-11. The phantom page is between p. 119 and p. 121.

FAA Response 161:

This problem does not occur in other copies of the document and may have inadvertently occurred in the document reviewed by this commentor during the reproduction process.

10.10 Comment 162 [Editorial]

Table B-2, p. 141, Stage 1 Area has no exponent

FAA Response 162:

This problem does not occur in other copies of the document and may have inadvertently occurred in the document reviewed by this commentor during the reproduction process.

11.0 Kistler Aerospace Corporation

11.1 Comment 163 [Other]

The Kistler Aerospace Corporation is pleased to respond to the Federal Aviation Administration's (FAA) request for comments on its Draft Programmatic Environmental Impact Statement for Commercial Launch Vehicles (September 1, 1999 revision).

Kistler notes that part of the FAA's charter is to "regulate and promote" the industry. Kistler believes that in the PEIS the FAA has made a significant contribution towards expediting future launch system environmental assessment efforts.

Kistler would, however, like to register some concerns. The majority of these concerns, as outlined below, focus around two of the proposed mitigation methods suggested by the FAA.

In developing and publishing the PEIS, the FAA should remain cognizant that it ultimately serves two purposes. The first is to be a resource for launch system operators conducting their environmental effort. The second, however, is as an introduction to the launch industry for agencies and communities surrounding candidate launch sites that have had no previous exposure to the industry. Care must be taken not to mislead this second audience.

Kistler feels that it is misleading to include in a list of proposed mitigation measures actions that are technically feasible, but which, in reality, are extremely unlikely to be implemented, and in fact, could contribute to an uninitiated candidate community losing the competition to host a launch operator.

FAA Response 163:

FAA appreciates Kistler Aerospace and others within the commercial launch industry taking time to comment on the Draft PEIS.

FAA disagrees with Kistler's position on excluding possible mitigation measures from section nine of the document. These mitigation measures are routinely used as necessary at launch complexes around the world. They are presented in this forum to serve as a brief discussion of measures that could be undertaken to mitigate possible detrimental impacts from launching vehicles on the local and global environment.

11.2 Comment 164 [Other]

In Section ES.7 Mitigation Actions (page xvi), the EA proposes "launch timing/seasonal restrictions, as needed" as a noise and wildlife impact mitigation measure. In Section 9.1 Noise (page 85) the FAA lists as a possible mitigation action "Restricting launches to optimal seasons…" and "Restricting launches to optimal times during the day…"

Discussion: While seasonal and diurnal restrictions may be placed upon an airport operation, this is extremely detrimental to launch operations. Time of launch is a significant parameter in determining the final orbital destination of the payload. Specifically, time of launch determines the longitude of the orbit's ascending node.

For a launch service, restricted daily operating hours do not simply translate into a delayed flight, as they would for an aircraft, but into unreachable destination orbits and the consequent loss of customers. Loss of market would be directly proportional to the amount of time each day that a launch were prohibited, i.e., if launches were forbidden for three hours in the morning and three hours in the afternoon, then on any given day, 25% of candidate payloads (customers) could not be launched.

Seasonal restrictions also lead to significant loss of market. While orbit destinations rendered unreachable during a seasonal shut down could be reached with a different launch time after restrictions end, such a delay would render a launch service completely unacceptable to a satellite orbit as quickly as possible after assembly.

It is clear that, while diurnal and seasonal launch restrictions are technically possible, they would be extremely detrimental to a launch operation. Consequently, they would realistically eliminate a candidate launch site from consideration.

Recommendation: Kistler would recommend that any reference to either seasonal or diurnal restrictions on launch operations as possible mitigation strategies be deleted from the PEIS.

FAA Response 164:

FAA appreciates the fact that commercial launch operators are concerned about profitability and are concerned with serving their customers to the best of their abilities. FAA is dedicated to helping licensed operators serve their customers in a timely manner. However, FAA also has other responsibilities to protect public safety and the environment.

FAA is not advocating that seasonal or diurnal restrictions should be implemented at all sites rather, FAA recognizes that in certain situations the delicate ecosystems around the launch complex may require restrictions on the season or timing of launches only as needed.

As for these measures being prohibitive enough to exclude customers from using the sites, it should be noted that the Kodiak Launch Complex (the only existing U.S. licensed launch site located on non-Federal land) has implemented seasonal launch restrictions to protect the breeding season on the Steller's eider. This launch site has been successfully launching vehicles since November 1998. Other launch sites around the world use these types of restrictions to protect local economic interests and the environment. In Japan, launches are restricted to certain seasons to permit fishing in the waters around the stage deposition areas. These measures have not so significantly affected the commercial launch industry so as to shut it down or prohibit payload customers from using these sites. In addition, implementing these mitigation strategies has prevented impacting the breeding season of a listed species of bird and potential negative socioeconomic impact of launching on a local community.

11.3 Comment 165 [Other]

In Section 2.3.3 Composite Vehicle Construction Alternative (page 18), the PEIS states, "These vehicles do not currently exist and there are no realistic plans to develop them in the near future."

Discussion: Kistler Aerospace Corporation is in fact building a vehicle, the K-1, whose structure is largely composite. Composite structure includes the payload fairing, the interstage, the intertanks, the thrust structure, and the fuel tanks on both stages. While the K-1 is not yet assembled, significant portions of this structure have been fabricated. Kistler believes it is misleading to state that "there are no realistic plans to develop composite vehicles in the near future.

Recommendation: Kistler recommends that the above quoted statement be changed to indicate that composite vehicles are the minority of the systems available and, consequently, this alternative would force satellite owners to rely upon foreign countries to launch their satellites.

FAA Response 165:

Launch vehicles constructed entirely or primarily of composite materials do not currently exist. While there are plans to develop vehicles whose component structures are largely composite (e.g., fuel tanks, fairing, interstage, etc.) these vehicles are not currently available. In addition, it is unlikely that vehicles will be constructed ***completely or exclusively*** from composite materials in the future. Launch vehicles contain a large number of individual parts and FAA does not anticipate a time when all of these parts are constructed from composite materials. It is acknowledged that all existing launch vehicles are composed of some composite materials (i.e., fuel tanks).

Clarifying text has been added to Section 2.3.3 so that this section now reads: "Under this alternative, the FAA would preferentially license those launches using vehicles that are entirely constructed of composite or exotic lightweight materials to make the vehicle lighter and therefore, not require as much fuel to reach orbit. It should be noted that all existing launch vehicles are composed of some composite materials (i.e., fuel tanks). However, vehicles composed completely of composite materials do not currently exist and there are no realistic plans to develop them in the near future."

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12.0 Space Access

12.1 Comment 166 [Other]

It is noted that the stated purpose of the document is to assess the environmental impacts of the operation of commercial Launch Vehicles (LVs), and to support licensing. The PEIS addresses existing launch sites as of the publication date as the basis for predicting acceptable impacts for potential new launch vehicles and sites. The history and documentation clearly shows no impact or no significant impact for the atmosphere, noise and for local launch environments (earth's surface effects) associated with the operation of commercial LVs.

FAA Response 166:

The PEIS examines in detail the potential impacts associated with licensed launches. The PEIS specifically examines three major impact categories: atmospheric, noise, and other environmental impacts. While cumulative impacts are expected to be minimal, it should be noted that there may be local impacts. In addition, specific sites may experience more significant impacts to the natural or human environments depending upon the type of launch vehicles employed at the site. For that reason some level of site-specific environmental documentation will likely be required for license applicants.

12.2 Comment 167 [Other]

Space Access appreciates the site-specific information presented to quantify the Earth's surface effects. The six different types of environments characterized include: Mid-Atlantic Coastal, Southeastern Atlantic Coastal, Southwestern Desert-Arid, South Central California Pacific Coastal, Subartic Pacific, and Sea-Launch environments. The ecosystems covered are for the existing federal and commercial launch sites with environmental impact statements – Wallops, Kennedy/Cape Canaveral, White Sands/Edwards, Vandenberg, Alaska, and Sea Launch. From the information presented it is not clear if new locations in the U.S. or U.S. territories are excluded from consideration. Space Access is considering sites in the covered ecosystems but also along the Gulf Coast; specifically, Texas, which is not covered in the PEIS. This document does not establish what impacts or upper limits might be considered acceptable in a Gulf Coast ecosystem. As a result, Space Access recommends that the FAA use site specific data to provide guidelines for the establishment of future sites, vehicles, and local Earth surface effects.

FAA Response 167:

These six environment types were selected primarily for two reasons. First, they represent major environment types across the U.S. Second, there is existing relevant documentation available to use as baseline data for these sites. It should be noted that the environment types in Texas are covered by the six types outlined in the PEIS. In particular, coastal sites along the Gulf Coast are similar to the environment types outlined in the Southeastern Coastal environment type. Other sites in Texas may be more similar to the Southwestern Desert-Arid environment type.

12.3 Comment 168 [Editorial]

Section 1.4 Scope of this PEIS. The first paragraph states, "For the purposes of this document, LVs are unmanned space vehicles with…" Since several specific references are made in the PEIS to the Space Shuttle, a manned system, Space Access recommends considering a reference

in the PEIS to all launch vehicles, manned and unmanned, be deleting the word “unmanned” from the first paragraph.

FAA Response 168:

The PEIS is intended to explore the effects of unmanned launches. Data that referenced the Space Shuttle were specific to the reusable nature of that fleet of vehicles and not their manned capability. Therefore, it was appropriate to use those data for the PEIS.

12.4 Comment 169 [Other]

Section 2.2 Preferred Alternative. The PEIS breaks down launch vehicles into categories of payload capacity, type of propulsion systems, and launch platforms. However, the PEIS shows that Launch Vehicles do not have significant atmospheric or noise impacts that depend on payload capacity, propulsion systems, or launch platforms.
The types of propulsion systems covered are really different propellants used in rocket engines: solid, liquid, cryogenic, hypergolic, and hybrid (liquid/solid). The FAA could also address different types of propulsion than rocket engines, such as the use of ram jet engines, that are likely in the near future. The FAA might also consider different types of launch methods, like horizontal takeoff versus vertical takeoff, and the associated environmental effects. Space Access would suggest that horizontal takeoff systems are expected to produce fewer environmental impacts that a vertical takeoff based system. Also, the document describes the environmental impacts of ground launch platform and sea-based systems and no significant information on air launch platform systems. Are there fewer impacts for air and sea-based platforms? The document describes an advantage of these platforms is to minimize environmental impacts, yet there is no incentive for their development since the PEIS appears to establish the acceptance of the environmental impacts of all existing systems, including launch systems with the highest pollutant levels from Solid Rocket Motors (SRMs). The FAA might consider categorizing launch vehicles as to the level or significance of impacts and establish a goal to reduce or minimize environmental impacts by gradually phasing out the worst category vehicles.

FAA Response 169:

As other types of propulsion systems such as ram jet engines become more feasible and as applicants begin to submit information to FAA, these systems will be considered for inclusion in the PEIS and other appropriate documentation. FAA is willing to work with the developers of new or modified technologies to ensure that these developments are sufficiently presented to the commercial launch community. This would also apply to information regarding the potential impacts of horizontal takeoff systems. FAA is interested in examining data produced by the developers of this technology and to ensure that this technology is sufficiently represented in future versions of documents like the PEIS. The PEIS recognizes the potential impacts associated with each propellant type but does not make statements to compare them. Statements to highlight one propellant or to exclude others is not consistent with the purpose of this document. The PEIS does not differentiate different types of launch methods. FAA licenses launch vehicles on a case-by-case basis because each LV operating from different launch sites will have different requirements and may pose differing degrees of impacts on the natural and human environments. National Environmental Policy Act documents are written to provide decision-makers with the best information to make environmental determinations

regarding licensing launch vehicles and launch sites within the maximum envelope of vehicle and site characteristics given the available data.

12.5 Comment 170 [Other]

Section 2.4.1 More Environmentally-Friendly Propellant Combinations Alternative. "Additional environmental characteristics that AST considered but rejected include:" Payload Capacity. "Lower capacity LVs tend to use less powerful engine systems and have lower emissions as compared to higher-capacity LVs." This is a clear implication that small launch vehicles are preferred over larger vehicles. Space Access believes as with other aspects of regulation, the FAA consider the benefit versus the risk relationship and normalize the data. In this case the emissions could be normalized by pound of payload delivered. With the data normalized, a small launch vehicle which is used multiple times to deliver the same mass to orbit may actually be more environmentally harmful than deploying the same payload on a single large launch vehicle.

FAA Response 170:

FAA does not have a preference for any size launch vehicle. FAA clearly recognizes that providing satellite customers with a variety of launch vehicles provides a worthwhile service to the industry. This variety of launch vehicle sizes will most likely continue to play an important role in the future of the industry. The data in the PEIS are presented and characterized in several ways, providing the reader with several different perspectives and FAA believes that these are sufficient to serve the purposes of this document.

There is no evidence to support the notion that normalizing emissions by pound of payload would lend credence to the theory that larger LVs would be less environmentally harmful. The relative impact of any LV would be dependent upon the vehicle configuration, propellant system, and operation of each specific vehicle.

12.6 Comment 171 [Noise]

Noise level. "In general, high capacity vehicles with the largest engines produce the most noise; however, if the launch site is in a very remote area, there may be very few receptors nearby to be affected by the noise." Space Access again recommends that the FAA consider normalizing the data by payload delivered to orbit and not imply small launch vehicles are better for the environment.

FAA Response 171:

Please refer to the response to comment 170.

12.7 Comment 172 [Other]

Section 2.4.1. More Environmentally-Friendly Propellant Combinations Alternative. "The environmental characteristic that AST considered and determined needed more detailed analysis is": Air Emissions. The third line states, "For example all propellant systems produce CO_2, which is a greenhouse gas." This statement is not true, however, for a hydrogen/oxygen propellant system. Therefore Space Access suggests replacing "all" with "many" and inserting "other than environmentally friendly system such as those based on hydrogen and oxygen after systems." Gradually phasing out solid rocket motors. Hypergolic or toxic oxidizers, and

hydrocarbon fuels as technology allows seems prudent, leaving only the more environmentally friendly systems.

FAA Response 172:

The word "all" has been removed from the document and replaced with the word "most." The other suggested reference claiming that hydrogen and oxygen based after systems were not added to the document as these claims are unsubstantiated.

12.8 Comment 173 [Air Quality]

Paragraph after section titled Air Emissions states, "Furthermore, conclusive data and analysis regarding the specific impacts of emissions from multi-propellant launch vehicles (e.g., liquid and solid combinations) do not exist." It is suggested that many of the large launch vehicles used to deploy payloads to geosynchronous orbits use a combination of solid and liquid propellants as does the Space Shuttle, which is well documented. Hence, it appears that most of the environmental impact data presented in this PEIS is based on launch vehicles that are multi-propellant.

FAA Response 173:

The FAA recognizes that some vehicles used for licensed launches and the Space Shuttle (a non-licensed vehicle) use two or more types of propellants. However, there is a distinction, these launch vehicles are primarily powered by liquids and use solid boosters. These boosters provide propulsion in a system that is not connected to the liquid propellant system. Therefore, for the purpose of this PEIS they are not considered to be liquid and solid combination launch vehicles.

12.9 Comment 174 [Other]

Last paragraph in section states, "Preferentially licensing those rockets that are not solely propelled by SRMs would reduce the total number of launches projected through 2009 to 134; see table 2-6. The number of launches using liquid, liquid/solid, or hybrid propellant systems was assumed to remain unchanged under this alternative." The alternative did not address licensing rockets that are not solely propelled by SRMs but "to preferentially license LVs with no SRMs or combinations of SRMs and liquids in the troposphere and stratosphere." Space Access recommends the FAA consider other means to encourage the use of environmentally friendly propellants. A licensing policy to gradually phase out less environmentally friendly propellants should be considered. When launch vehicles are available that are environmentally friendly the FAA should consider policies to preferentially license those vehicles.

FAA Response 174:

This comment has been noted. FAA encourages innovation of new launch technologies and propellant systems which may minimize the environmental impacts of licensed launches and will consider such an alternative should it become feasible in the future.

12.10 Comment 175 [Other]

Section 3.3.3 Local Water Resources. Mid-Atlantic Coastal Environment. The statement is made that, "The sea level is expected to rise due to the combined effects of land subsidence and fluctuations in global temperatures." This statement is only made in this section and is reference

to global warming not necessarily a direct environmental effect of launch activity. Space Access suggests this discussion is not pertinent to this PEIS.

FAA Response 175:

Launches are one of many sources believed to contribute to global warming as stated repeatedly in the PEIS. Although launches are a minor contribution to global warming when compared to other industry sources it is still valid to include launches in the list of factors contributing to the overall global warming.

12.11 Comment 176 [Editorial]

Section 3.3.5. Marine Species in Atlantic and Pacific Oceans. Space Access recommends this be discussed under Section 3.3.4 Sea Environment.

FAA Response 176:

This section was provided as a separate section because it is relevant to all existing launch sites supporting expendable launch vehicles. Expendable launch vehicles fly over ocean environments and jettison spent stages into the open ocean and some of the proposed reentry launch vehicles are expected to overfly ocean environments and therefore potential accident scenarios which could impact the ocean environments must be considered. Therefore Section 3.3.5 remains a separate section of the PEIS and will not be combined with the Sea Environment Section.

12.12 Comment 177 [Air Quality]

Section 5.1.1 Troposphere. Ground Cloud Near Launch Site. First paragraph states, "A ground cloud forms within the first 10-12 seconds of an LV launch." This is only true for vertical takeoff rocket engine launch vehicles. The ground cloud is uniquely hazardous from SRMs. Space Access recommends inserting, "vertical takeoff" before LV to properly describe this activity.

FAA Response 177

The PEIS does not differentiate different types of launch methods. As additional data on viable horizontal launch vehicles become available, the FAA will review it and consider adding this information to the PEIS and other relevant documents.

12.13 Comment 178 [Air Quality]

Section 5.1.2 Stratosphere. Global Warming. The fourth paragraph states, "The estimated total CO_2 emissions from LV launches into the troposphere for the period 1998-2009 is 25,000 tons (see Appendix A)." The section is only about the stratosphere but all the information is presented about injecting emissions causing greenhouse gas effects into the troposphere. In Section 5.1.1 Troposphere it states "Environmental effects from CO_2 occur in the stratosphere and therefore are discussed in section 5.1.2. The other emissions are either insignificant or will not be harmful to the troposphere." The information in Appendix A does discuss the emissions into both the troposphere and stratosphere but the information used in this section is specific to the troposphere. It is suggested that clarification of what information is used for this analysis be included.

FAA Response 178:

The amount of CO_2 emissions expected from launches is being modified for publication in the final version of the PEIS as the range of the launch period is being updated. The new data will more accurately reflect the deposition of CO_2 into the stratosphere.

12.14 Comment 179 [Noise]

Section 5.2.1 Noise Impacts on Human Beings. The fourth paragraph states, "The committee on Hearing, Bioaccoustics, and Biomechanics of the National Academy of Sciences/National Research Council has set an exposure limit of one impulse/day at 7.25 psf. Based on the above, no health effects are anticipated." Space Access recommends the FAA establish this as a maximum acceptable value.

FAA Response 179:

The FAA will continue to license launch vehicles based on the specific details of each LV at a particular location. Setting an exposure limit of one impulse/day at 7.25 psf may put unnecessary restrictions on future launches in particular locations and for specific situations.

12.15 Comment 180 [Noise]

Section 5.2.3 Noise Impacts on Structures. The second paragraph states, "Sonic booms are propagated towards the ground only when the vehicle pitches over during flight." Space Access recommends inserting, "Vertical takeoff launch vehicle" at the front of the sentence to properly describes what causes this impact.

FAA Response 180:

The PEIS does not differentiate different types of launch methods. If horizontal launch technology becomes viable, FAA will consider the impacts of sonic booms associated with these vehicles in the PEIS and other relevant documentation.

13.0 Vela Technology Development Inc.

13.1 Comment 181 [Editorial]

Executive Summary Page vii, Line 1-2. Delete "unmanned": unwarranted restrictive adjective.

FAA Response 181:

The referenced sentence reads "The FAA's office of the Associate Administrator for Commercial Space Transportation (AST) is responsible for issuing licenses for the launch of launch vehicles (LVs)".

13.2 Comment 182 [Programmatic Content]

Executive Summary Page vii. This PEIS should describe potential impacts to any (all encompassed within this document) generic locations for the launch of any (characteristics stipulated within) type of LV. Any subsequent specific LV requesting a license, to the extent its characteristics fall within the parameters discussed within this document, should be covered by this PEIS and require no additional EIS documentation; else why have the generic documentation to being with.

FAA Response 182:

FAA produced this programmatic document to address generic impacts to potential launch sites and from both existing and proposed LVs. This document is provided to assist the license applicant in partially fulfilling the requirements placed upon them under the National Environmental Policy Act for federal entities (FAA) undertaking major federal actions (licensing) that have the potential to significantly affect the quality of the human environment. CEQ regulations and FAA Order 1050.1D encourage the use of tiering to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for discussion at each level of the environmental review. FAA feels that this document provides a significant resource to license applicants for completing environmental documentation for each specific launch. This document could not begin to address all potential site specific environmental impacts associated with a particular launch vehicle operating in a specific environment. These detailed analyses will need to be analyzed in site specific environmental documentation.

13.3 Comment 183 [Editorial]

Note "a" Page vii lines 1-2. Does this intend to exclude single stage (including suborbital) expendables from this PEIS? Change "…that jettison or release expended stages (usually over water) with no intent to recover or reuse these components…" to "that have stages or components that are not intended for recovery or reuse…"

FAA Response 183:

Footnote "a" has been revised to read: "Launch Vehicles (LVs) in this Programmatic Environmental Impact Statement are comprised of both expendable launch vehicles (ELVs) that have stages or components that are not intended for recovery or reuse, and reusable launch vehicles (RLVs) that have stages or components that can return to Earth and be recovered and reused." Similar changes were made to Footnote "c."

13.4 Comment 184 [Editorial]

Note “b” Page vii Line 1: Redefine: this definition is inappropriate; more than one “payload” has provided key operational data to the rest of the launches during flight. And, in some the “payload” may be the launcher! (e.g., RLVs) And, what may be “payload” to one trajectory may be launcher to another, making “payload” wholly inappropriate and indefinable for the purposes of the PEIS.

FAA Response 184:

This definition of payload is currently accepted in the Dictionary of Scientific and Technical Terms as well as by Webster’ Dictionary. This PEIS used a definition of “payload” that was appropriate and sufficiently detailed for the majority of launch events. If a definition of appropriate simplicity and accuracy is developed in the future, it will be incorporated into the PEIS.

13.5 Comment 185 [Editorial]

ES.1 Page viii. Definition “payload capacity.” Redefine this category as “amount of impulse encompassed in the LV”: Any environmental impact is influenced by the amount of overall impulse (use of propellants, leaving of exhaust products, etc) more directly than the actual mass of some artificially defined “payload” that is carried “to orbit” (especially when non-orbiting LVs are included in this PEIS). And, as written, the impacts described herein are as much or more functions of the orbit itself than they are of the “payload” mass. You're after the “amount of impact (emissions)” from the system. Thus, total impulse [f(propellant mass expended in region of interest)] is more of a correlating factor than “payload” mass.

FAA Response 185:

In the interest of maintaining simplicity in the text of this document, and not compromising the scientific integrity of the document FAA believes that this section was sufficiently well defined.

13.6 Comment 186 [Editorial]

ES.1 Page vii Definition: types of prop systems. Delete the parenthetical: few, if any, LV “types of propulsion systems” are defined by “the mechanisms that change the momentum of the vehicle by changing the velocity of the air moving through the system.”

FAA Response 186:

This definition is generally accepted industry-wide to explain in relatively basic terms the function of propulsion systems.

13.7 Comment 187 [Editorial]

ES.2 Page vii. Line 2-6. Change to read: “This PEIS, though it encompasses the characteristics and impacts to many specific sites, is not site specific; any required site-specific environmental documentation not already encompassed by this generic document would be developed as needed.” Make this PEIS worth something and generically cover the impacts of “all” known LV types against “all” known launch sites.

FAA Response 187:

This PEIS incorporates relevant characteristics of all existing expendable launch vehicles used for commercial payloads as well as many proposed RLVs and encompasses all environments for licensed U.S. licensed launch sites.

13.8 Comment 188 [Editorial]

ES.2.3 Page x. Delete: "…, an unmanned space vehicle with the ability to operate in, or place payloads in outerspace that is intended to be used only once,…". This is no place for a definition of ELV to be placed. And, in addition, to date there have been no manned vehicles that haven't been either totally or largely expendable.

FAA Response 188:

This definition of ELVs will be removed from Section ES 2.3 as a definition is provided in a footnote of the PEIS.

13.9 Comment 189 [Editorial]

ES.2.3 Page x. Change: "…, less than 0.5 mammals per year are…" to "…, less than one mammal every two years is…". While mathematically correct, it is ludicrous to represent an impact as hitting a half of anything at anytime.

FAA Response 189:

FAA will clarify this sentence in the text to read "As detailed in the appendix, fewer than 0.5 animal strikes are expected annually, even when all launch activity is summed, and a summation is done across all species over both the Atlantic and Pacific Oceans." For purposes of the PEIS a "strike" refers to harassment, injury or death of a marine animal.

13.10 Comment 190 [Other]

ES .2.4. Page x. What about the beneficiaries of the orbiting material? Will it have no impact on people whose jobs are other than "highly skilled workers with specialized skills and education"? The impact if not doing this alternative is the loss of the orbiting material as well as the loss of the launchers' jobs.

FAA Response 190:

Please note that for the purposes of this document FAA assumed that international launching entities would begin to launch a greater percentage of the "orbiting material" and therefore these satellites etc. would still be available although they would not be launched by U.S. corporations. Therefore, only the impacts of the loss of jobs was considered in this case.

13.11 Comment 191 [Launch Manifest]

ES.3. Page x. The results of this alternative is not reduction in the number of launches; but, rather, the reduction in types of licensable launchers in the U.S. marketplace. Reword this to make it a(n) (executive) summary of the findings later in this document consistent with the assumed no reduction in number of launches made in the "No Action" alternative. Even the

numbers of launches in the U.S. are not likely to come down significantly, rather, some launchers are put out of business and others will more likely flourish.

FAA Response 191:

The alternative referenced by the commentor would reduce the number of launches in the U.S. As is stated throughout the document, the net number of world-wide launches is not expected to change (i.e., world wide demand for launch providers is not expected to decrease). Therefore, the number of non-U.S. launches would increase to address the additional demand for launch services. This document only specifically addresses U.S. launches as the FAA has regulatory authority for those launches. FAA believes that these topics are adequately addressed in the PEIS.

13.12 Comment 192 [Other]

ES.3 Page xi. This alternative is mostly a sham with the definition explained here to include only those "rockets" "solely propelled by SRMs." It implies that, at least, Titan, Delta, and Shuttle launches are not addressed in this section at all. The issue in this section can only be the use or non-use of SRMs. If they are used, this alternative should seek to preferentially exclude them. If they are an adverse impact, then any launcher's use of them should be considered not just those few that are wholly reliant upon them.

FAA Response 192:

It should be noted that Shuttle launches are not licensed launches and therefore are not impacted by decisions regarding the licensing of vehicles used for licensed launches.

Please see PEIS Section 2.3.1 where an alternative similar to the one described in this comment was considered and excluded from further consideration because it was deemed to be not feasible. The National Environmental Policy Act requires analysis of all reasonable alternatives to ensure that the document was thorough in its assessment of potential impacts.

13.13 Comment 193 [Editorial]

Note "c" Page 1. Change "…that jettison or release expended stages over water with no intent to recover or reuse these components…" to "that have stages or components that are not intended for recovery or reuse…".

FAA Response 193:

This suggestion will be implemented in the final version of the PEIS.

13.14 Comment 194 [Editorial]

Section 1.4. Page 2. Delete "unmanned": unwarranted restrictive adjective.

FAA Response 194:

The referenced sentence reads "For the purpose of this document, LVs are launch vehicles with the ability to operate in, or place payloads in, outer space."

13.15 Comment 195 [Other]

Section 1.4. Page 3. Delete "Construction activities, if they occur, will be addressed in separate site-specific environmental documentation." Construction is not a licensable activity and is therefore outside the FAA purview for purposes of NEPA. Therefore, no such promises as written can be made, or are warranted, by the FAA in this document.

FAA Response 195:

Construction; as a component of any new proposed licensed launch or launch site requiring an FAA license, ***must*** be addressed as part of NEPA documentation for the proposed action. To fail to do so would constitute segmentation which is prohibited by CEQ Regulations.

13.16 Comment 196 [Other]

Section 4.4. Page 48. "Reusable Vehicles" Delete reference to use of composites in "reusable vehicles." It is totally out of place since it is left out of consideration in any other launch vehicle configuration, all of which also make use of these materials. Or, if it is needed for "Reusable's," it is also needed everywhere else as well.

FAA Response 196:

The discussion of composite material with respect to accidents during vehicle ascent has been moved further up in this Section and as such is applicable to all LVs and not just RLVs.

13.17 Comment 197 [Editorial]

Section 5. Page 49. Delete last two sentences: although references, there actually are no paragraphs 5.6 or 5.7 in this document. And, as referenced, the topics listed as covered in these paragraphs do not actually belong in this section in any case.

FAA Response 197:

These sentences will be deleted from the document.

13.18 Comment 198 [Editorial]

Section 6.1. Page 74. Replace erroneous reference to "nitrous oxide (N_20) with correct reference to nitrogen oxide(s)" (NO_x). And, are you sure you want to list "water vapor" among the "greenhouse gases" with which we supposedly have a concern.

FAA Response 198:

The references will be corrected in the document. However, water vapor is a listed greenhouse gas and will remain in the document.

13.19 Comment 199 [Other]

Section 6.2. Page 76. Does this consider the impact potential of actually preferring noisier large liquid launchers over less noisy small SRMs?

FAA Response 199:

FAA does not understand the commentor's question. No such assertion is made in the PEIS.

13.20 Comment 200 [Editorial]

Section 3.1.1. Page 23. Correct formula for molecular nitrogen is "N_2" not "N_2O" as shown in the text and the correct formula for nitrous oxide is "N_2O" (as shown in the glossary) not "NO" as shown in the text.

FAA Response 200:

These comments will be addressed in the final version of the PEIS.

PRIVATE CITIZEN

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14.0 Private Citizen (Raymond A. Vaselich)

14.1 Comment 201 [Other]

Page 1, section 4, Potential Accident Scenarios. Include launcher segment break up or explosion in space. As a result of construction of a permanent space station the bounds of the human environment have been expanded. The creation of additional orbit debris is now recognized as a significant danger not just to the crew of the station but to man's commercial space aspirations.

FAA Response 201:

Orbital debris including debris from a possible but highly unlikely explosion in space will be handled as dictated in relevant regulations. FAA does not feel that it is appropriate to consider such an unlikely scenario specifically in this PEIS. General information regarding orbital debris has been added to Section 3.1.5 – Orbital Debris Reentering Earth's Atmosphere and 9.7 – Orbital Debris Mitigation. In addition, please refer to the response to comment 6.

14.2 Comment 202 [Propellants]

Page vii, Section ES.2. Expand to include detonation of SRM propellant on first motion, on impact immediately after the first motion, and down range. SRM propellant is in some cases thicker than the critical diameter for detonation of the material. There have been even been cases of propellant have detonated after impact on a beach.

FAA Response 202:

FAA believes that the PEIS considers the primary accident scenarios and would expect for a greater level of detail to be included in environmental and mission safety reviews for specific launch vehicles using SRMs. The particular situations described in this comment are unusual and therefore may not be appropriate to consider in this PEIS.

14.3 Comment 203 [Other]

Page x, Section ES.2.3, last paragraph, last three lines. Address here or in appendix B why a direct hit is required to permanently injure or kill a marine mammal when an extremely high velocity object strikes a water surface. Another option would be to delete this discussion on grounds data to define velocity and mass of an object capable of killing marine mammal species or the required overpressure to do so are unknown. Objects striking water surface at high velocity can produce high pressure pulses which have the potential to damage auditory sensors. Further the assumption in the appendix relative to lethality of the larger pieces as opposed to many smaller pieces (page 132, first paragraph) is hard to support unless you have specific data on the required mass and velocity capable of killing or permanently injuring the specific species. An analogy would be the use of a shotgun with a single slug or with multiple pellets for hunting deer.

FAA Response 203:

Under the Marine Mammal Protection Act of 1972, the potential of a proposed project to kill, injure, or harass a marine mammal must be considered. Thus the marine animal survey provided in the PEIS considers potential impacts to marine animals from U.S.

licensed launches. Potential impacts from a “strike” included acts resulting in death, injury, or harassment. Therefore, the potential of launch debris impacting the water with sufficient force to produce overpressure waves that may cause hearing damage in marine animals was accounted for in the marine animal strike analysis.

14.4 Comment 204 [Other]

Page xv, Section ES.5.1, paragraph 4, line 8. Quantify "rare events" of the nature being discussed. Later sections address reliability of launches in terms of success rates - that is to place the object in its desired orbit. This can not be directly translated to all cases resulting in an "accident" in which a launcher is destructed while still containing propellant.

FAA Response 204:

The accident rate will vary depending on the specific vehicle proposed to be used. These success rates would be expected to be included in specific environmental documentation if appropriate or in mission safety review documentation. The phrase “rare events” was removed from the document and replaced with the following sentence: “Although on a cumulative basis the likelihood of accidents occurring increases as the number of launches increases, accidents involving launch vehicles are relatively uncommon events primarily because launches of these vehicles are infrequent events especially as compared to other traditional modes of transportation. It should be noted that the FAA assumes a failure probability ranging from 10% to 31%, depending on the number of missions flown by a vehicle. Therefore, the overall cumulative impacts from accidents are insignificant as compared with other emission sources.” A successful launch is one in which the satellite is placed into orbit and the vehicle operates as it is intended. It would be possible for a vehicle to operate properly and the satellite not to be placed successfully into orbit.

14.5 Comment 205 [Propellants]

Page 9, Section 2.2.3, second paragraph, line 6. Identify the oxidizer with the “PBAN and aluminum powder” propellant in the example. Propellants usually require an oxidizer, binder and additional fuel. The binder can serve as the fuel.

FAA Response 205:

The following phrase has been added to the document: “…and solid propellant (e.g., polybutadiene matrix acrylonitrile oxidizer and powdered aluminum).”

14.6 Comment 206 [Editorial]

Page 11, Table 2-5. Modify to incorporate the sea drilling platform launcher now operated by Boeing and its partners. The consortium has demonstrated at least two successful launches, one of which included a commercial payload.

FAA Response 206:

References throughout the document will be modified to reflect changes in launch manifests and other recent events.

14.7 Comment 207 [Other]

Page 18, Section 2.3.1, Non Solid Propellant Alternatives. Clarify in terms of EELV PEIS prepared by Air Force last year with, I believe, FAA as a cooperating agency. As late as last year the two largest U.S. launch providers in a co venture with the USAF proposed launcher designs which were predominantly liquid systems. In light of the final EELV EIS prepared to support use of these liquid propellant systems it would appear that at least some clarification and discussion is required. The USAF is preparing a supplemental EELV EIS which will address modified designs which incorporate SRMs to improve EELV payload flexibility and thus reduce costs. However, the trade off environmentally between the liquid vs. liquid/solid designs and capabilities should be at least addressed or referenced if the USAF final supplement is distributed before this EIS.

FAA Response 207:

FAA has served as a cooperating agency both for the final EELV EIS and the EELV Supplemental EIS. FAA is aware of the developments of both proposed families of launch vehicles. There is reference to the results of the RISO study stating that LO_x/Kerosene launch vehicles may have a greater potential to deplete ozone than was previously thought. As information about the relative impacts of solid and liquid propulsion systems becomes available, FAA will consider adding this information to subsequent revisions of the PEIS.

14.8 Comment 208 [Other]

Page 43, Section 4.2, United States Historical Launch Success Rate. Update launch success rates and discuss failure rate which is anticipated for new generation of launchers just entering the field based on past initial development failures resulting in the loss of over $3.5 billion and associated launch delays. These should be incorporated into your statistics. Two new families of vehicles, the EELV's are entering the field shortly and new designs or significantly modified designs usually have a high early failure rate which reduces with maturity.

FAA Response 208:

The PEIS is not intended to detail the success rates of all launch vehicles by type. It is true that new, or significantly modified launch vehicles initially may have a higher failure rate than mature launch vehicles. The following statement has been added to Section 4.2 "As new or significantly modified launch vehicles are introduced to the market they may initially experience a higher failure rate than mature launch vehicles." It is not appropriate to discuss the specific potential launch success or failure rate of the EELV launch vehicles.

14.9 Comment 209 [Safety]

Page 47, section 4.4, "For launch of an ELV over water, the consequences of an accident at this point in the flight profile would be limited to the atmosphere and oceans." Expand to include impact with oil drilling platforms off for example Vandenberg or ships off Florida coast. The oil rigs are not always abandoned during launches and even then a direct hit could lead to the release of oil which could contaminate critical habitat on the shore. Further it is my understanding that conducting launches while ships are still in the areas normally cleared is under consideration. Debris hits on a tanker or other ship transporting hazardous material could severely impact shore environment.

FAA Response 209:

The FAA's safety approach seeks to ensure that debris would not impact any ship. The FAA's regulations state that a launch operator shall initiate flight:

only if the collective risk to any water-borne vessel that is not operated in direct support of the launch does not exceed a probability of impact (Pi) of 0.00001 (Pi£1´10-5) during launch vehicle flight.

14.10 Comment 210 [Editorial]

Page 55, Section 5.1.3, line 3, "infrequency of these events." Define infrequent or provide U.S. history. Clarify and completeness.

FAA Response 210:

It is not appropriate to quantify the individual U.S. launch vehicles historical success rates in this document. The PEIS is intended to facilitate the process as future launch operators complete environmental documentation as part of their license applications. The FAA uses an expected failure rate of 10% which was chosen as an acceptably conservative value while not overly penalizing seasoned launch vehicles. The first three flights of a new vehicle generally have a failure rate of around 30%.

14.11 Comment 211 [Editorial]

Page 73, last line, "Ongoing US Air Force and industry research…" Provide expected date of completion and reference to any specific preliminary reports on the research. Completeness.

FAA Response 211:

As new research is developed and published this document will be updated and the FAA will include the information presented in these research documents in any future reviews. FAA cannot anticipate a release date of research in which FAA is not a guiding participant. FAA is aware of these and other research studies due to the fact that FAA is involved in dialogues with researchers and regularly participates in conferences and workshops to share results of new studies as they are released.

INDEX

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APPENDIX A

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APPENDIX B

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