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ORIGINAL

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U. S. Department of Transportation Dockets
Docket No. FAA-1999-5535- 2 3
400 Seventh Street SW, Room Plaza 401
Washington, DC 20590

Subject: Notice of Proposed Rulemaking (NPRM)

Title: Commercial Space Transportation Reusable Launch Vehicle and Reentry Licensing

Attached are Kelly Space & Technology, Inc. (KST) errata sheets and revised comments to subject KST NPRM comments. Some reference numbers were incorrect. There are no substantive changes. These changes are provided as clarification only.

Sincerely,

Robert N Keltner

Robert N. Keltner
Project Manager

Errata sheet to NPRM COMMENTS

Submitted by Kelly Space & Technology, Inc.

Docket No. FAA-1999-5535

(Page numbers refer to NPRM comment sheet)

1. Page 2, item 14, (format change only)

2. Page 3, item 21, Change reference item from "14" to "13".

3. Page 3, item 25, Change reference item from "15" to "14".

4. Page 5, item 44, Change reference item from "40" to "43".

5. Page 6, item 46, Change reference items from "40 and 41" to "43 and 44".

6. Page 6, item 48, Change reference items from "40, 41, 42" to "43, 44 and 46".

7. Page 7, item 53, Change reference item from "48" to "52".

8. Page 7, item 55, Change reference item from "48" to "52".

9. Page 12, item 74, Change reference item from "58" to "62".

10. Page 14, item 78, Change reference item from "73" to "77".

11. Page 15, TABLE A, Change items at left margin as follows from "52, 53, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 65, 66 and 67" to "56, 57, 58, 59, 60, 61, 63, 64, 65, 66, 67, 68, 69, 70 and 71", respectively.

12. Page 16, item 88, Add "Reference items 43, 44, 46 and 48".

13. Page 17, item 91, Change items "69 and 70, page 109" to "items 73 and 74".

14. Page 17, item 92, (format change only).

15. Page 17, item 94, Change reference item "87" to "92".

16. Page 18, item 95, Change format and delete "page 38" after "item 26".

17. Page 18, item 97, (format change only).

18. Page 18, item 100, Add "Reference items 43, 44, 46, 48 and 88".

19. Page 18, item 101, Change reference item from "95" to "100".

20. Page 18, item 102, Add "Reference items 43, 44, 46, 48, 88, 100 and 101".

21. Page 19, item 103, Change "item 65, page 105" to "item 69".

22. Page 19, item 105, Change reference item "8 1" to "85".

Revision A, 8-9-99

NPRM COMMENTS

Docket No. FAA-19994535
Submitted by Kelly Space & Technology, Inc. (KST)

(Page numbers refer to WEB site version of NPRM)

Background, General

1 Page 5, 2nd para.:
Comment: Change "Expendable Launch Vehicle" to "ELV."

2 Page 6, 1st para.:
Comment: Change "an unpopulated" to "a sparsely populated."

3 Page 6, last par-a. states ". . . .it is generally expected that reentering space objects burn up upon reentry into the Earth's atmosphere and do not present a threat to public safety."
Comment: Though most often true however, large pieces of debris have been found on numerous occasions. Landing constraints upon RLV should not be more stringent than this threat. The FAA should quantify this threat for comparison, rather than making this general statement,.

4 Page 7, 1st para. states ". . vehicles performance can be demonstrated through rigorous testing and numerous flights. . . ."
Comment: Change to read "...through rigorous ground test, simulation and flight tests." Considering the nature of RLV's, requiring "numerous" flights could kill the industry. Concentrate on rigorous ground tests and simulation before flying.

Background, Reentry Vehicle and Reusable Reentry Vehicle Proposals

5 Page 7: Reentry Vehicles and reusable Launch Vehicle Proposals, Title
Comment: Change heading to "Reentry Vehicle.. ." (singular)

6 Page 7, last par-a., 1st line:
Comment: Change "vehicle" to "vehicles"

7 Page 8, last line:
Comment: Change "Aerospace" to "Space & Technology, Inc."

8 Page 9, last par-a.:
Comment: Heartily agree with last paragraph. Certification at this point in RLV history would be foolhardy.

9 Page 9, 6th from last line:
Comment: Change ". . . with safety. . ." to ". . . with the safety. . ."

History of Commercial Reentry Capability

10 Page 10, last line:
Comment: Change "... expendable launch vehicle." To "... ELV."

11 Page 11, 7th from last line:
Comment: Change "... Expendable Launch Vehicle..." to "... ELV..."

12 Page 12, last paragraph:
Comment: Heartily agree with the approach to safety approval.

Lessons Learned from COMET/METEOR Safety Approved Criteria

13 Page 17, middle paragraph:
Comment: The third prong of the inter-related safety approach must be defined in sufficient detail for evaluation.

General Approach to Reusable Launch Vehicle and Reentry Licensing Mission Risk Assessment

14 Page 23, first two paragraphs: Re; combining launch and reentry authorization under a single license and single operator.
Comment: The proposal approach appears to be the most reasonable. With this approach, once the E_c criteria are firmly established, allocation of risk between the launch and reentry phases would not be an issue.

15 Page 24, 2nd para.:
Comment: Change to read, "... would be eligible. . . ", "... indemnification, only to the extent. . . "

16 Page 25, last par-a,:
Comment: Agree that FAA must define clearly the extent of activities that comprise the E_c analysis. This is true, however, for all criteria. All criteria must be at a sufficiently high level to preclude dictating design solutions.

17 Page 26, 2nd par-a., last sentence:
Comment: Agree that reentry readiness activity is important to the overall risk calculation.

18 Page 29, 1st para.:
Comment: Agree with definition of the interface between launch and reentry activity.

19 Page 29, 1st para.:
Comment: Although it might be obvious, the end of licensed reentry activity should be defined. Suggest that the following be added before the last sentence. "The licensed reentry phase ends when the RLV touches down on earth."

20 Page 29, 1st para., last sentence:
Comment: Suggest the following definition for a planned or designed-in reentry delay. "When the mission includes a planned or designed-in delay, the reentry phase begins with the initiation of procedures for reentry preparation."

21 Page 29, last par-a.:
Comment: As in item 13, the third prong of the inter-related safety approach must be defined in sufficient detail for evaluation.

22 Page 30, 1st para.:
Comment: The phrase, "general applicability," itself, requires careful definition.

23 Page 3 1, last pat-a. :
Comment: Heartily agree with the described approach.

24 Page 33, 2nd para., next to last sentence.
Comment: The sentence states that launches will be licensed if equivalent safety is demonstrated. Change to read ". . . demonstrated as defined in the Licensing Plan."

25 Page 3 5, 2nd para., last sentence:
Comment: Agree with defining risk on a per mission basis. This allows the developer to allocate risk between launch and reentry to take maximum advantage of the characteristics of the developer's concept. Reference item 14.

26 Page 38, last paragraph:
Comment: The assumption of a $p_f = 1$ is so conservative it could easily doom the RLV industry. The developer should be allowed to calculate a p_f using the same approach to system reliability that has become standard with the aerospace industry for decades.

27 Page 41, 1st par-a.:
Comment: In determining the documentation required for the system safety approach, it is important that documentation normally prepared as a requisite to the development process be used to the maximum extent possible. Reducing "special" requirements to a minimum will reduce development costs and contribute to the economic viability of the RLV industry.

28. Page 42, 2nd para.:
Comment: This paragraph states that system performance verification might be accomplished in 10-20 flights. The following paragraphs address the use of simulation and ground tests as a substitute for some of the flight tests. It is hoped that this approach can reduce the number of flight tests to six or fewer. Reference item 4.

29. Page 43, 2nd para. :
Comment: The "effects of prior flight on vehicle performance" must include both maintenance and refurbishment criteria.

30. Page 43, 3rd para. :
Comment: The term "sufficient data" should be described and quantified in the developer's Licensing Plan.

31. Page 44, middle para. states ". . . shall not have substantial dwell time.. . ". The following paragraph states that "substantial" and "densely" will be evaluated on a case-by-case basis.
Comment: It is suggested that neither phrase need be used in the license evaluation, but rather evaluate on the basis of E_c or whatever risk measure has been accepted by the FAA for a specific concept and Licensing Plan.

32. Page 46, 2nd para., 1st sentence.
Comment: Heartily agree with the philosophy of not mandating adherence to a, flight test regime to demonstrate vehicle capability.

33. Page 46, last par-a. and Page 47, 1st para.:
Comment: Heartily agree with the philosophy expressed in this paragraph regarding the adverse impact upon the RLV industry of the imposition of a specific flight-test requirement.

34. Page 47, last para. in Section A:
Comment: It is suggested that the developer propose in his licensing plan a specific validation program consisting of several elements, e.g. – System Acceptance Tests, computer simulations, ground tests, flight tests, etc. The plan would include specific FAA acceptance criteria for each phase, all of which must be completed satisfactorily before the vehicle was considered "proven." The phases in some instances would not necessarily be sequential, i.e. – System Acceptance Tests need not be completed as a pre-requisite to computer simulations or ground tests. However, all other validation phases would have to be completed satisfactorily before commencing flight tests.

35. Page 50, last para., 2nd sentence:
Comment: Sentence is incomplete. However, the implication is that a pilot can exercise sufficient control during reentry to minimize the landing footprint. Heartily agree with this philosophy.

36. Page 5 1, 1st para. states, ". . . nominal vehicle operations. . . ":
Comment: There must be prior agreement between the FAA and the developer regarding the definition of "nominal" for a specific vehicle. The method for determining this definition should be identified in the Licensing Plan for that vehicle.

37. Page 5 1, last para., 5th sentence states, ". . . may only be appropriate for. . . ":
Comment: Change to read ". . . may be appropriate only for. . . ".

38. Page 52, last para.:
Comment: Heartily agree with the philosophy that does not mandate any particular type of Flight Safety System.

39. Page 54, 2nd para., 5th line:
Comment: Change "?6" to read "-6" (superscript).

40. Page 54, last para. and page 55 to end of Section 1:
Comment: Agree in principle with the licensing approach. However, page 55, 2nd par-a. uses the phrase "several successful reentry's? The term "several" must be defined more specifically, e.g. – two, three, four? It would appear that this should be a single number applied to all developers across the board.

41. Pages 56 and 57, last sentence:
Comment: In accordance with earlier comments, when risk is defined on a mission basis as described on page 35, the developer is able to allocate launch and reentry risk to take maximum advantage of the characteristics of the developer's concept. Ref. item 14 and 25.

42. Page 58, Section 401.5 Definitions, 1st para. :
Comment: Add "Exempted-class rocket activities"' Expectation of Casualty" and "Impacted Landmass" to list of definitions

43. Page 66, Section 43 1.27, Denial of policy approval
Comment: Place a time limit upon the FAA policy approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue.

44. Page 67, Section 43 1.3 1, General, last para.:
Comment: Place a time limit upon the FAA safety approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference item 43.

45. Page 68, last para.:
Comment: The 1st and last sentences of this paragraph address "rehearsals". This should be a requirement only in special circumstances, e.g.-during the test flight phase or following a significant vehicle modification. The modification parameters requiring dress rehearsals and flight tests should be defined as a part of the Licensing Plan.

46. Page 79, Section 43 1.47, Denial of safety approval, 1st para.:
Comment: Place a time limit upon the FAA safety approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43 and 44.

47. Page 79, Section 43 1.47, Denial of safety approval, Subpart D – Payload Reentry Review and Determination, last sentence:
Question: The proposed rule states that a summary determination can be requested by the developer if the risks to public safety posed by the payload were substantially similar to a previously approved payload reentry determination issued earlier to another RLV mission license applicant. How does the developer obtain this information? Is this a matter of public record?

48. Pages 80 and 8 1 , Section 43 1.55, Payload reentry review:
Comment: Place a time limit upon the FAA payload reentry review process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43,44 and 46.

49. Page 8 1 , Section 43 1.55, Payload reentry review:
Comment: This section refers to issues addressed by the FAA in a payload reentry review. Although the agencies to be consulted are identified, general information relating to reentry should be provided to the developer prior to the developer submitting the licensing plan and to the applicant (if not a developer) at the time of the request for application.

a. U. S. national security
b. U.S. foreign policy interests
c. International obligations
d. Other

In addition to these general issues, there will probably be concept-unique issues, which could not be addressed before submittal of the Licensing Plan by the developer.

50. Page 91, Section 435.23, Policy review requirements and procedures, Subpart C:
Comment: Definition of the safety evaluation process should be contained in the developer's Licensing Plan. This should be obtained from the FAA by the developer during preparation of the licensing plan.

5 1. Page 92, Section 43 5.3 5, Acceptable reentry risk for reentry of reentry vehicle, Subparts D and E:
Comment: These Subparts are currently blank. This information should be provided to the developer at a date sufficient for the developer to review before the NPRM review deadline.

52. Page 94, Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle, 1st and last para.:
Comment: The estimated average burden hours equate to ≈2. lman-years and seem low. If not already accomplished, the FAA should use the experience derived from certification of aircraft, not as a baseline, but as a reference point for determination of this burden rate. This information should be requested from the aircraft manufacturers, who should be pleased to provide the information. It is our opinion that the proposed burden would be several times greater than that proposed. Collecting of the historical data is essential to establish an initial baseline for RLV's. After collection of the historical data, it should be evaluated to identify the most critical elements affecting RLV licensing. This minimal data set can then be used to establish RLV history while minimizing economic impact upon the developer.

Regulator-v Evaluation Summary

53. Page 95, Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle:
Comment: Based upon the results of the survey of aircraft manufacturers proposed in item 52, the Regulatory Evaluation Summary may or may not be valid.

54. Page 96 Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle:
Question: The paragraph shows an estimated cost of $113 million dollars discounted to $65 million over a 15-year period, of which the commercial space launch industry would incur 27 percent. What ground rules and assumptions were used in this discounting?

55. Page 96 Section 43 5.3 5, Acceptable reentry risk for reentry of a reentry vehicle:
Comment: The $30 million figure distributed among 5- 10 developers is $3-6 million for each developer over a 15-year period for an average of $200,000-$400,000 per year. If this includes all costs for Licensing Plans, meetings, reviews, negotiations, etc. required for the initial development this seems low. Specific comments for each area are addressed under subsequent items. Reference item 52 for related comments.

Industry Compliance Costs

56. Page 98, Section 43 1.25, Application Requirements for Policy Review and Section 435.23 Policy Review:
Comment: The estimated cost for fulfillment of application requirements appears low for two reasons: (1) time per application and (2) loaded salary. Although it appears that much of the application information can be used as "boiler plate" for applications after the initial preparation, considerably more than eight hours could be consumed in preparation and

coordination. The hourly figure is probably low by a factor of 2 or 3. The loaded salary used is about $50 per hour. The average "wrap rate" for most aerospace companies is closer to $100 per hour. Combining the two factors means the cost per application is probably in the neighborhood of $1,600 rather than $400. On page 55, the NPRM states "The term of operator license would be set at a 2-year renewable period. Using the figure of $1,600 per application over the 2-year period equates to $800 per year or $12,000 per operator over the 15-year period. The total cost for all five operators would be $60,000.

57. Page 99, Section 43 1.33, Safety Organization and Section 43 5.25, Safety Review Requirements and Procedures:
Comment: Using a loaded salary of $100 per hour, which is characteristic of most aerospace companies, this estimate is low by a factory of two. The compliance cost will be about $200,000 per year for each operator or $15 million (5X $200,000 X 15) over the 15-year period.

58. Page 99, Section 43 1.35, Acceptable Reusable Launch Vehicle Mission Risk, and Section 43 5.3 5, Acceptable Reentry Risk for Reentry of a Reentry Vehicle:
Comment: The parameters used to develop these cost figures are not identified. It is assumed, however, that the same loaded salary was used for this as in previous calculations. This would indicate the projected costs are too low by a factor of two, equating to a cost of $1,600,000 per operator or $8 million for all 5 operators. Assuming the first year cost is based upon the same loaded salary, actual first-year costs would be approximately $1.5 million. The estimated recurring cost of $3,600 annually equates to $54,000 over the 15-year period. Using the more realistic labor rate, the total cost would be $108,000. The relationship between recurring cost and term of the operator's license is unknown. If the $3,600 was developed by assuming a license term of 15 years instead of 2 years, amortizing the total cost over the 15-year period, the total recurring cost assuming a 2-year term could be 7X the more realistic cost or $756,000 per operator. If this is the case, the total cost could be as high as $11.3 million, consisting of $1.5 million first-year, plus $756,000 recurring for each operator times five operators. If there were no relationship between recurring cost and term of the license, total costs would be $8 million.

59. Page 100, Section 43 1.37, Mission Readiness and Section 43 5.33 , Safety Review Requirements and Procedures:
Comment: Assuming the 80-hour preparation time is a reasonable number and the same labor rate was used as in previous calculations, this cost is also too low by a factor of two. This equates to a real cost of $8,000 per application, which is an annual cost of $533 per operator. If this requirement is related to the license term, the annualized cost could be 7.5 X as great for a 2-year term or $4,000 per year for each operator. This equates to $60,000 per operator for the 15-year period. Total cost for five operators would be $300,000. If there were no relationship between this requirement and license term, the total cost would be $40,000.

60. Page 100, Section 43 1.39, Mission Rules, Procedures, Contingency Plans and Checklists, and Section 43 5.3 3, Safety Review Requirements and Procedures:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $180,000 over the 15-year period and a total cost of $900,000 for all five operators.

61. Page 101, Section 43 1.4 1, Communications Plan Section and Section 435.33, Safety Review Requirements and Procedures :
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $180,000 over the 15-year period and a total cost of $900,000 for all five operators.

62. Page 101, Section 43 1.43, Reusable Launch Vehicle Mission Operational Requirements and Restrictions and 43 5.33 , Safety Review Requirements and Procedures 2nd para. :
Comment: This paragraph refers to "limitations on dwell time over populated areas." This is clearly a new requirement not imposed by E,. For E_c calculations the Instantaneous Impact Point (IIP) is a continuously moving "footprint" along the RLV trajectory traversing continuously changing population densities. As noted in the NPRM, population density is multiplied by the casualty area of the vehicle to determine the consequence of a failure event. E_c does not include a time function. Although reason dictates that the risk of casualty is less over an area that is sparsely populated than one that is densely populated, it is impractical to assume that commercial operations will be performed only over sparsely populated areas. Should a catastrophic event occur on a large aircraft approaching a densely populated urban area, the probability of casualties is very great. However, aircraft are not prevented from using these airports because the perceived risk is low. This is primarily because the airline industry has been very fortunate that so few accidents have occurred over very densely populated areas such as apartment buildings, shopping centers and theaters.

It should be noted that if E_c calculations were performed for airlines, the E_c would be much greater over urban areas than sparsely populated areas just as for ELV's or RLV's. For takeoff and landing, risk to the population in the immediate takeoff and approach path is much greater for at least two reasons: probability of failure (P_f) is somewhat greater and the exposure time (or dwell time) is much greater. Takeoff and landing speeds for large aircraft are approximately one-fourth the cruising speed and, conversely, exposure time is four times as great. Therefore, although total risk to the population in the takeoff and approach path is significantly greater, E_c calculations are affected only by the P_f calculation. Dwell time does not enter the calculation. Since aircraft have no utility unless they can takeoff and land, this greater risk is accepted. The same philosophy should be applied to ELV's.

63. Page 103, Section 43 1.43, Reusable Launch Vehicle Mission Operational Requirements and Restrictions and 43 5.33 , Rest and Duty Restrictions:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $6.4 million over the 15-year period and the total cost would be $32 million for all 5 operators.

64. Page 103, Section 43 1.45, Mishap Investigation Plan and Emergency Response Plan, and Section 43 5.3 3 , Safety Review Requirements and Procedures:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $1,084 million over the 15-year period and the total cost would be $5.42 million for all 5 operators,

65. Page 103, Section 43 1.57, Information Requirements for Payload Reentry Review, and Section 43 5.43, Payload Reentry Review Requirements and Procedures:
Comment: This requirement appears similar to that addressed on page 98, Section 43 1.25. Similarly, the estimated cost for fulfillment of application requirements appears low for two reasons: (1) time per application and (2) loaded salary. Although it appears that much of the application information can be used as "boiler plate" for applications after the initial preparation, considerably more than eight hours could be consumed in preparation and coordination. The hourly figure is probably low by a factor of 2 or 3. The loaded salary used is about $50 per hour. The average "wrap rate" for most aerospace companies is closer to $100 per hour. Combining the two factors means the cost per application is probably in the neighborhood of $1,600 rather than $400. On page 55, the NPRM states "The term of operator license would be set at a 2-year renewable period. Using the figure of $1,600 per application over the 2-year period equates to $800 per year, or $12,000 per operator over the 15-year period. The total cost for all five operators would be $60,000.

66. Page 104, Section 43 1.73, Continuing Accuracy of License Application; Application for Modification of License:
Comment: This requirement appears similar to that on page 98, Section 43 1.25 and 435.23, however the numbers are significantly different. Moreover, the NPRM appears to assume that only one modification application would be submitted over the 15-year period. This is highly unlikely, since each operator would submit 8 applications during the 15-year period, it is not unreasonable to assume that one-half would require modification within the 2-year licensing term. This would increase the number of applications by a factor of four. The hourly rate is too low by a factor of two as explained in previous comments. Therefore, compliance costs would be $264,000 (2X4X$33,000) for each applicant or $1.32 million for all five operators over the 15-year period.

67. Page 104, Section 43 1.75, Agreements and Section 435.5 1 , Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: The requirement to advise the FAA of compliance with the Federal range agreements may, indeed, require negligible effort, however the cost to the operator is dependent upon the means of notification. Paragraph 43 1-75(b)(2) needs to clarify the procedures or paperwork required by the FAA. There is clearly cost involved, which could be significant.

68. Page 105, Section 43 1.77, Records and Section 435.5 1 Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: It is assumed that the same labor rate was used for this estimate as for the others. Assuming the time estimate in the NPRM is reasonable, the actual cost would be $800 per entity per year. Over the 15-year period, the cost would be $12,000 (800X 15) per entity or $60,000 (5X$12,000) for five entities.

69. Page 105, 157 and 158 Section 431.79, Reusable Launch Vehicle Mission Reporting Requirements and Section 435.5 1 Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: The requirement to provide information addressed in paragraph 43 1.79(a) and (b) specifies two reports, one at 60 days and one at 15 days before launch. Part (c) requires reports of accidents and incidents. Although this is a contingency, the time requirement could be significant. This paragraph needs to clarify the procedures and paperwork involved to provide this information to the FAA. Regarding the contingency reporting, it is suggested that some assumptions be made regarding frequency of occurrence – perhaps 5-8 reports over the 15-year period. There is clearly cost involved for parts (a), (b) and (c), which could be significant.

Paragraph 43 1.79 requires two reports, one not less than 60 days, the other not less than 15 days before each licensed RLV mission. A provision needs to be added to accommodate quick turn-around missions, e.g. - 3-7 days. Perhaps this could be accomplished with a detailed flight plan for planned events, but quick turn-around from an aborted mission also needs to be addressed.

70. Page 106 and 160, Section 43 1.93, Environmental Information and Section 43 5.6 1 , Environmental Review (General):
Comment: It is a well-known fact that attempts to comply with the plethora of environmental laws have killed many commercial projects. The FAA needs to become very pro-active in this area to prevent the death of RLV's aborning. Section 43 1.93 (a)-(d) identifies specific environmental requirements, however, part (e) states simply "other factors as necessary." There is insufficient time during the NPRM comment period to research the environmental laws in this area. In fact, it will take months to research this thoroughly and even then, miss a "killer" requirement, of which there may be many. It is worth repeating that the FAA, supported by Congress, must be very aggressive in this area.

The costs proposed in the NPRM assume a time requirement of 5,420 man-hours or approximately 2.5-3.0 man-years for each operator over a 15-year period, which equates to an average of less than 7 hours per week. The wording of Section 43 1.93 implies one reentry site. There is certainly a multiplier for this when multiple launch and reentry sites are considered. Considering the labor rate, multiple sites, and the uncertainties and unknowns, the estimate could be low by an order of magnitude. It is suggested that the estimate is too low by a factor of five. If this is the case, incremental compliance costs are probably much closer to $1.36 million per operator or $6.8 million for five entities over the 15-year period. The absolute minimum, using a realistic labor rate, is $542,000 per operator or $2.71 million for five entities over the 15-year period.

7 1. Page 106 and 162, Section 433.7, Environmental:
Comment: Using the logic addressed in item 66, this estimate is probably too low by a factor of five, if not an order of magnitude. Considerations include the labor rate, multiple sites and the uncertainties and unknowns. Incremental compliance costs are probably much closer to $810,000 per operator or $4.1 million for all five entities over the 15-year period. The absolute minimum, using a realistic labor rate, is $324,000 per operator or $1.62 million for the five entities over the 15-year period.

72. Page 106, FAA Administrative Costs:
Comment: Although industry comment may be inappropriate, it is suggested that FAA administrative costs will have a direct relationship to industry costs. Therefore, since industry costs will be much greater than that estimated in the NPRM, administrative costs will more likely approximate $166 million over the 15-year period, rather than the $83 million estimate.

73. Page 109, Benefits, (1):
Comment: The difficulty in determining economic benefits when human lives are at risk is understandable. However, the $30X10^{-6}$ number used as a measure of merit by the test ranges should be re-examined. This re-examination is, in fact, one of the follow-on action items identified by the RLV Working Group and it is presently in work.

74. Page 109, Benefits, (2):
Comment: The public expected casualty of $1X10^{-6}$ is much too stringent for application to the public adjacent to reentry sites. The same logic can be used here that was addressed in item 62. The fact that the exposure time is many times as great as the average exposure time and the population is expected to be much more dense near some landing sites simply compounds the problem in meeting this requirement. Although an allocation between launch and reentry risk needs to be made, the $1X10^{-6}$ number should also be re-examined. Since the expectation of casualty for launch and reentry is combined, the proper approach is to let the developer perform the allocation based upon the E_c criteria. This would allow maximum flexibility based upon the specific characteristics of the developer's concept, creating the most efficient regulatory approach.

75. Page 112, Benefits, last two sentences:
Comment: The calculation of costs on pages 96- 108 appears reasonably straightforward. The calculation of benefits, however, is extremely esoteric, determined as follows:

Step 1 identified (6) accident types grouped in (2) categories related to airborne explosions and ground point-of-impact crashes.

Step 2 assigned monetary values to each of the various types of accidents expected to occur during launch and reentry.

Step 3 assigned probabilities to each of the (6) accident types based on percentage of impacted landmass for the baseline and the proposed rule.

Step 4 estimated expected values for each accident type under the baseline and the proposed rule.

Step 5 calculated the expected benefit as the difference between the baseline and the proposed rule.

More information is required in terms of the specific numbers used for these calculations.

76. Page 112, Secondary Benefits:
Comment: Although the development process, without regulatory procedures, requires a great deal of paperwork, it is difficult to imagine that the additional paperwork required by the regulatory process could possibly result in enhanced operational efficiency which in turn should result in decreased costs. Exactly the opposite should be expected. It is a rather circular argument to state that secondary benefits would accrue due to enhancing efficiency because of clarifying regulatory and procedural processes which would not even be necessary were there no licensing process. These comments should not be construed as opposing the licensing process, rather a concern that the licensing process is represented as a cost saving to the developer or operator, which is an invalid assumption.

77. Page 113, Summary of Total Costs and Benefits:
Comment: The attached TABLE A summarizes costs addressed in items 52-67, pages 98-106. As the summary indicates, the estimated industry compliance costs obtained from the individual items are actually slightly more than $34 million instead of the $30 million shown in Table 1. Using the more probable labor rate of $100 per hour, the minimum most likely industry compliance cost will be $68 million. Using the other factors described in the individual items, the most likely industry compliance cost will be $78 million. Using the apparent discount rate of. 554, the discounted costs are as shown:

Commercial Space Transportation Industrv Compliance Costs

	Undiscounted	Discounted
FAA Estimate	$3 4 million	$19 million
Minimum Likely	$68 million	$3 8 million
Most Likely	$78 million	$43 million

Federal Aviation Administration Implementation Costs

FAA Estimate	$83 million	$45 million
Total Cost	$113 million	$65 million
Minimum Likely	$23 4 million	$128 million
Most Likely	$244 million	$133 million

78. Page 114, Initial Regulatory Flexibility Determination, 2nd para:
Comment: The SBA has defined small business as entities comprising fewer than 1,000 employees. In fact, the five small, entrepreneurial businesses have fewer than 100 employees. Only two of those purporting to develop RLV's have an employee base approximating 1,000. In accordance with the cost assessment on pages 98-106, the total 15-year cost for five operators is estimated by the FAA to be $34 million, equating to $6.8 million per operator. As noted in Table A, the actual cost would be $68-78 million or $13.6 - $15.6 million per operator. Reference Item 77.

79. Pages 114- 116, Initial Regulatory Flexibility Determination, 3rd through last para:
Comment: As noted above, the actual annualized compliance cost for each operator over the 15-year period is $907,000 - $1.04 million per year. The entire premise of RLV viability is based upon reduced launch costs. Although cost estimates between operators vary, it is not unreasonable to assume that RLV launch costs would be approximately one-half that of ELV launch costs. The NPRM also appears to assume that RLV's would capture the entire ELV market. This is surely not the case. It is probably reasonable to assume that RLV's capture one-half of the ELV market. When these two assumptions are combined, the average income per year for each of the five RLV operators is likely to average one-fourth that of current ELV operator income. Using a worst-case assumption of four launches per year, instead of the seven assumed in the NPRM, then $25 million per launch produces annual revenue of $100 million. Using the calculated compliance cost of approximately $1 million annually results in 1.0 percent of the anticipated annual revenue. It must be assumed that initial costs will be significantly higher than average cost over the 15-year period. Assuming initial costs are 2 times the average equates to $2 million annually. Assuming development time of greater than 3 years, equates to $6 million + during the development phase. This is during a period when there is no revenue stream. Based upon the previous calculations, a regulatory flexibility analysis may be required.

TABLE A

Proposed versus Actual Costs

Location	Estimate	Proposed Actual Min (1)	Most Probable (2)	Difference (1)	(2)
56, page 98, Costs	$ 2,000	$ 8,000	$ 60,000	$ + 6,000	$ 58,000
57, page 99, 43 1.33	8,000,000	15'000,000	15,000,000	+7,000,000	+7,000,000
58, page 99, 43 1.35	4'000,000	8,000,000	11,300,000	+4,000,000	+7,300,000
59, page 100'431.37 435.33	20,000	40'000	3 00'000	+20,000	+280,000
60, page 100'431.39 435.33	450,000	900,000	900,000	+450,000	+450,000
61, page 101, 431.41 435.33	450'000	900'000	900'000	+450,000	+450,000
63, page 103, Rest & Duty Restrictions	16,000,000	32,000,000	32,000,000	+16,000,000	+16,000,000
64, page 103, 43 1.43 435.33	2,700,000	5,420,000	5,200,000	+2,720,000	+2,720,000
65, page 103'431.57 435.43	2'000	8,000	60,000	+6,000	+ 58,000
66, page 104, 431.73	165,000	1,320,000	1,320,000	+1,155,000	+1,155,000
67, page 104'431.75 435.51	0		significant		+ significant
68, page 105'431.77 435.5 1	30,000	60,000	60,000	+3 0'000	+3 0'000
69, page 105, 431.79 435.51	0		significant		+ significant
70, page 106, 431.93 435.61	1,400,000	2,710,000	6,800,000	+ 1'3 10'000	+5,400,000
71, page 106, 433.7	810,000	1,620,000	4'100'000	+820,000	+3,300,000
Total	$34' 119,000	$67,986,000+	$78,220,000+	$33,967,000+	+$44,201,000+

Estimated Cost: $34,000,000

Summary of most probable cost: $68,000,000 - $78,000,000

80. Page 116, International Trade Impact Assessment:
Comment: The proposed rule probably has an effect upon international trade regarding operations from foreign soil. One example is that of U.S. companies opting to operate from foreign soil because of reduced risk. Some nations may require a less stringent expectation of casualty (E,) calculation than that required by U. S. federal ranges and the proposed rule. In others, the population density may be so small that the E_c prescribed by this rule can be met easily. In either case, it may be more attractive to operate from foreign soil.

8 1. Page 120, Section 400.2, Scope, last sentence:
Comment: Add to "40 1.5 Definitions" the phrase "Exempted-class rocket activities."

82. Page 12 l, Section 40 1.5, Definitions, Launch:
Comment: This definition should be revised, e.g. – last sentence should be changed to read, "Flight ends when the RLV touches down on the earth following reentry."

83. Page 122, Section 40 1.5, Definitions, Launch Vehicle:
Comment: Change "suborbital" to "sub-orbital."

84. Page 123, Section 401.5, Definitions, Operation of a reentry site:
Question: The definition states, "Operation of a reentry site means the conduct of safety operations. . . .". Are safety operations the only consideration for operation of a reentry site? Suggest the definition be changed to indicate a more general definition. Add the caveat that safety of operations is the sole consideration of AST if such is the case.

85. Page 126, Section 405.1, Monitoring of licensed and other activities:
Comment: After 1st sentence add the following: "Access to operator's facilities will be on a non-interference basis to the maximum extent possible."

86. Page 127, Section 405.5, Emergency Orders:
Comment: Last sentence is incomplete.

87. Page 127, Section 406.1, Hearings:
Comment: Paragraph (a)(1) is incomplete.

88. Page 139, Section 431.3 1, General, (c):
Comment: Place a time limit upon the FAA safety review process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46 and 48.

89. Page 140, Section 43 1.33, c(l) and c(2):
Comment: These paragraphs address "dress rehearsals" and "mission readiness determination". These should be requirements only in special circumstances, e.g.-during the test flight phase or following a significant vehicle modification. The modification parameters requiring dress rehearsals, mission readiness determination and flight tests should be defined as a part of the Licensing Plan.

90. Page 140, Section 43 1.35, Acceptable reusable launch vehicle mission risk, (a), 2nd sentence:
Comment: Sentence states "...mission commences upon initiation of launch phase of flight, ..". However, on page 121, Launch, 2nd and 3rd sentence state: "The term launch includes the flight of a launch vehicle and pre-flight ground operations beginning with the arrival of a launch vehicle or payload at the U.S. launch site. Flight ends after the licensees' last exercise of control over its launch vehicle." It is probably not the FAA's intent to include all pre-flight ground operations in the mission risk calculation. Change to read, "... mission commences upon initiation of the vehicle launch countdown,..." or something similar.

91. Page 141, Section 43 1.35, Acceptable reusable launch vehicle mission risk, (b) (1) and (2):
Comment: The expectations of casualty $30X10^{-6}$ and $1X10^{-6}$ were addressed previously under items 73 and 74.

92. Page 146, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (c) (2):
Comment: Paragraph (c) (2) states " substantial dwell time over densely populated areas... ". The term "substantial" must be defined, either specifically or by providing criteria for calculation.

93. Page 146, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (c) (3):
Comment: Paragraph (c) (3) states "There will be no unplanned physical contact between the vehicle or its components and payload... ". This is like the old joke directive "There shall be no more mid-air collisions." Change to read, "The method of payload separation shall ensure no contact between the deploying vehicle and payload following separation and shall not generate debris that could damage the deploying vehicle or its payload," or something similar.

94. Page 147, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (d) (1):
Comment: Same as comment 92. Define "substantial."

95. Page 147, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (d) (2) :
Comment: Paragraph (d) (2) states, ". . . given a probability of vehicle failure equal to 1 (p_f = 1) at any time the IIP is over a populated area;" As noted previously, the assumption of p_f = 1 is overkill and should be re-examined. The term "populated" needs to be defined in terms of population density. Reference item 26.

96. Page 149, Section 43 1.45, Mishap investigation plan and emergency response plan, (c):
Comment: Add "(MIP)" after "mishap investigation plan."

97. Page 150, Section 43 1.45, Mishap investigation plan and emergency response plan, following (c) (9):
Comment: Add (c) (10) "A MIP shall be submitted as part of the application process."

98. Page 149, Section 43 1.47, Denial of safety approval, 1st sentence:
Comment: Place a time limit upon the FAA safety review process. Notification of the denial of safety approval should occur within that given period. There shall also be a "fast track' issue for resolution, which would not require another complete review. It should address only those item(s) for which safety approval was denied.

99. Page 15 l, Section 43 I .53, Classes of payloads, (a):
Comment: Paragraph (a) states, "The FAA may approve ", Change "may" to "must".

100 Page 152, Section 43 1.55, Payload reentry review, (e):
Comment: Place a time limit upon the FAA reentry review process. Notification of issues should occur as soon as possible following identification (say 5 working days) but no later than the end of the review period. There should also be a "fast track' for issue resolution, which would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46, 48, and 88

101 Page 152, Section 43 1.59, Issuance of payload reentry determination, (a) 2nd sentence:
Comment: Same as item 100. Place time limit upon review.

102 Page 155, Section 43 1.73, Continuing accuracy of a license application; application for modification of license, (e):
Comment: Place a time limit upon FAA license modification review. Notification of issues should occur as soon as possible following identification (say 5 working days) but no later than the end of the review period. There should also be a "fast track' for issue resolution, which would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46, 48, 88, 100 and 101.

103 Page 157, Section 43 1.79, Reusable launch vehicle mission reporting requirements, (a) and (b):
Comment: Same as item 69. Need to address quick turn-around.

104 Page 157, Section 43 1.69, Reusable launch vehicle mission reporting requirements, (c), 1st sentence:
Comment: Sentence states, ". . . or other mishap immediately." Define the term "immediately," possibly "within 24 hours," or something similar.

105 Page 158, Section 43 1.83, Compliance monitoring:
Comment: Sentence states, "A licensee shall allow access by.. . " Add the qualification, ". . . on a non-interference basis to the maximum extent possible." Reference item 85.

106 Page 164, Section 435.3, Types of reentry licenses, (a) Reentry specific license:
Question: When an expendable upper stage is used with a reusable first stage, does the launch license include authorization to de-orbit and reentry the upper stage? If not, it should.

Errata sheet to NPRM COMMENTS

Submitted by Kelly Space & Technology, Inc.

Docket No. FAA-1999-5535

(Page numbers refer to NPRM comment sheet)

1. Page 2, item 14, (format change only)

2. Page 3, item 21, Change reference item from "14" to "13".

3. Page 3, item 25, Change reference item from "15" to "14".

4. Page 5, item 44, Change reference item from "40" to "43".

5. Page 6, item 46, Change reference items from "40 and 41" to "43 and 44".

6. Page 6, item 48, Change reference items from "40, 41, 42" to "43, 44 and 46".

7. Page 7, item 53, Change reference item from "48" to "52".

8. Page 7, item 55, Change reference item from "48" to "52".

9. Page 12, item 74, Change reference item from "58" to "62".

10. Page 14, item 78, Change reference item from "73" to "77".

11. Page 15, TABLE A, Change items at left margin as follows from "52, 53, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 65, 66 and 67" to "56, 57, 58, 59, 60, 61, 63, 64, 65, 66, 67, 68, 69, 70 and 71", respectively.

12. Page 16, item 88, Add "Reference items 43, 44, 46 and 48".

13. Page 17, item 91, Change items "69 and 70, page 109" to "items 73 and 74".

14. Page 17, item 92, (format change only).

15. Page 17, item 94, Change reference item "87" to "92".

16. Page 18, item 95, Change format and delete "page 38" after "item 26".

17. Page 18, item 97, (format change only).

18. Page 18, item 100, Add "Reference items 43, 44, 46, 48 and 88".

19. Page 18, item 101, Change reference item from "95" to "100".

20. Page 18, item 102, Add "Reference items 43, 44, 46, 48, 88, 100 and 101".

21. Page 19, item 103, Change "item 65, page 105" to "item 69".

22. Page 19, item 105, Change reference item "81" to "85".

Revision A, 8-9-99

NPRM COMMENTS

Docket No. FAA-1999-5535
Submitted by Kelly Space & Technology, Inc. (KST)

(Page numbers refer to WEB site version of NPRM)

Background, General

1 Page 5, 2nd para.:
Comment: Change "Expendable Launch Vehicle" to "ELV."

2 Page 6, 1st para.:
Comment: Change "an unpopulated" to "a sparsely populated."

3 Page 6, last para. states ". . . .it is generally expected that reentering space objects burn up upon reentry into the Earth's atmosphere and do not present a threat to public safety."
Comment: Though most often true however, large pieces of debris have been found on numerous occasions. Landing constraints upon RLV should not be more stringent than this threat. The FAA should quantify this threat for comparison, rather than making this general statement,.

4 Page 7, 1st para. states ". . .vehicles performance can be demonstrated through rigorous testing and numerous flights.. . ."
Comment: Change to read ". . . through rigorous ground test, simulation and flight tests." Considering the nature of RLV's, requiring "numerous" flights could kill the industry. Concentrate on rigorous ground tests and simulation before flying.

Background, Reentry Vehicle and Reusable Reentry Vehicle Proposals

5 Page 7: Reentry Vehicles and reusable Launch Vehicle Proposals, Title
Comment: Change heading to "Reentry Vehicle.. ." (singular)

6 Page 7, last para., 1st line:
Comment: Change "vehicle" to "vehicles"

7 Page 8, last line:
Comment: Change "Aerospace" to "Space & Technology, Inc."

8 Page 9, last para.:
Comment: Heartily agree with last paragraph. Certification at this point in RLV history would be foolhardy.

9 Page 9, 6th from last line:
Comment: Change ". . . with safety. . ." to ". . . with the safety. . ."

History of Commercial Reentry Capability

10 Page 10, last line:
Comment: Change ". . . expendable launch vehicle." To ". . . ELV."

11 Page 11, 7th from last line:
Comment: Change ". . . Expendable Launch Vehicle. . ." to ". . .ELV. . ."

12 Page 12, last paragraph:
Comment: Heartily agree with the approach to safety approval.

Lessons Learned from COMET/METEOR Safetv Approved Criteria

13 Page 17, middle paragraph:
Comment: The third prong of the inter-related safety approach must be defmed in sufficient detail for evaluation.

General Approach to Reusable Launch Vehicle and Reentry Licensing Mission Risk Assessment

14 Page 23, first two paragraphs: Re; combining launch and reentry authorization under a single license and single operator.
Comment: The proposal approach appears to be the most reasonable. With this approach, once the E_c criteria are firmly established, allocation of risk between the launch and reentry phases would not be an issue.

15 Page 24, 2nd para.:
Comment: Change to read, ". . . would be eligible. . .", ". . . indemnification' only to the extent. . ."

16 Page 25, last para,:
Comment: Agree that FAA must define clearly the extent of activities that comprise the E_c analysis. This is true, however, for all criteria. All criteria must be at a sufficiently high level to preclude dictating design solutions.

17 Page 26, 2nd par-a., last sentence:
Comment: Agree that reentry readiness activity is important to the overall risk calculation.

18 Page 29, 1st par-a.:
Comment: Agree with definition of the interface between launch and reentry activity.

19 Page 29, 1st para.:
Comment: Although it might be obvious, the end of licensed reentry activity should be defined Suggest that the following be added before the last sentence, "The licensed reentry phase ends when the RLV touches down on earth."

20 Page 29, 1st para., last sentence:
Comment: Suggest the following definition for a planned or designed-in reentry delay. "When the mission includes a planned or designed-in delay, the reentry phase begins with the initiation of procedures for reentry preparation."

21 Page 29, last par-a.:
Comment: As in item 13, the third prong of the inter-related safety approach must be defined in sufficient detail for evaluation.

22 Page 30, 1st par-a.:
Comment: The phrase, "general applicability," itself, requires careful definition.

23 Page 3 1, last para. :
Comment: Heartily agree with the described approach.

24 Page 33, 2nd par-a., next to last sentence.
Comment: The sentence states that launches will be licensed if equivalent safety is demonstrated. Change to read ". . . demonstrated as defined in the Licensing Plan."

25 Page 3 5, 2nd par-a., last sentence:
Comment: Agree with defining risk on a per mission basis. This allows the developer to allocate risk between launch and reentry to take maximum advantage of the characteristics of the developer's concept. Reference item 14.

26 Page 38, last paragraph:
Comment: The assumption of a p_f=1 is so conservative it could easily doom the RLV industry. The developer should be allowed to calculate a p_f using the same approach to system reliability that has become standard with the aerospace industry for decades.

27. Page 41, 1st para.:
Comment: In determining the documentation required for the system safety approach, it is important that documentation normally prepared as a requisite to the development process be used to the maximum extent possible. Reducing "special" requirements to a minimum will reduce development costs and contribute to the economic viability of the RLV industry.

28. Page 42, 2nd para.:
Comment: This paragraph states that system performance verification might be accomplished in 10-20 flights. The following paragraphs address the use of simulation and ground tests as a substitute for some of the flight tests. It is hoped that this approach can reduce the number of flight tests to six or fewer. Reference item 4.

29. Page 43, 2nd para.:
Comment: The "effects of prior flight on vehicle performance" must include both maintenance and refurbishment criteria.

30. Page 43, 3rd para.:
Comment: The term "sufficient data" should be described and quantified in the developer's Licensing Plan.

3 1. Page 44, middle para. states ". . . shall not have substantial dwell time.. . ". The following paragraph states that "substantial" and "densely" will be evaluated on a case-by-case basis.
Comment: It is suggested that neither phrase need be used in the license evaluation, but rather evaluate on the basis of E_c or whatever risk measure has been accepted by the FAA for a specific concept and Licensing Plan.

32. Page 46, 2nd para., 1st sentence.
Comment: Heartily agree with the philosophy of not mandating adherence to a flight test regime to demonstrate vehicle capability.

33. Page 46, last para. and Page 47, 1st para.:
Comment: Heartily agree with the philosophy expressed in this paragraph regarding the adverse impact upon the RLV industry of the imposition of a specific flight-test requirement.

34. Page 47, last para. in Section A:
Comment: It is suggested that the developer propose in his licensing plan a specific validation program consisting of several elements, e.g. – System Acceptance Tests, computer simulations, ground tests, flight tests, etc. The plan would include specific FAA acceptance criteria for each phase, all of which must be completed satisfactorily before the vehicle was considered "proven." The phases in some instances would not necessarily be sequential, i.e. – System Acceptance Tests need not be completed as a pre-requisite to computer simulations or ground tests. However, all other validation phases would have to be completed satisfactorily before commencing flight tests.

3 5. Page 50, last para., 2nd sentence:
Comment: Sentence is incomplete. However, the implication is that a pilot can exercise sufficient control during reentry to minimize the landing footprint. Heartily agree with this philosophy.

36. Page 5 1, 1st para. states, ". . . nominal vehicle operations. . . ":
Comment: There must be prior agreement between the FAA and the developer regarding the definition of "nominal" for a specific vehicle. The method for determining this definition should be identified in the Licensing Plan for that vehicle.

37. Page 51, last para., 5th sentence states, ". . .may only be appropriate for.. .":
Comment: Change to read ". . . may be appropriate only for.. . ".

3 8. Page 52, last para. :
Comment: Heartily agree with the philosophy that does not mandate any particular type of Flight Safety System.

3 9. Page 54, 2nd para., 5th line:
Comment: Change "?6" to read "-6" (superscript).

40. Page 54, last para. and page 55 to end of Section 1:
Comment: Agree in principle with the licensing approach. However, page 55, 2nd para. uses the phrase "several successful reentry's" The term "several" must be defined more specifically, e.g. – two, three, four? It would appear that this should be a single number applied to all developers across the board.

41. Pages 56 and 57, last sentence:
Comment: In accordance with earlier comments, when risk is defmed on a mission basis as described on page 35, the developer is able to allocate launch and reentry risk to take maximum advantage of the characteristics of the developer's concept. Ref. item 14 and 25.

42 Page 58, Section 401.5 Definitions, 1st para. :
Comment: Add "Exempted-class rocket activities", Expectation of Casualty" and "Impacted Landmass" to list of definitions

43. Page 66, Section 43 1.27, Denial of policy approval
Comment: Place a time limit upon the FAA policy approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track' for issue resolution that would not require another complete review. It should address solely resolution of the specific issue.

44. Page 67, Section 43 1.3 1 , General, last para. :
Comment: Place a time limit upon the FAA safety approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference item 43.

45. Page 68, last para.:
Comment: The 1st and last sentences of this paragraph address "rehearsals". This should be a requirement only in special circumstances, e.g.-during the test flight phase or following a significant vehicle modification. The modification parameters requiring dress rehearsals and flight tests should be defined as a part of the Licensing Plan.

46. Page 79, Section 43 1.47, Denial of safety approval, 1st par-a. :
Comment: Place a time limit upon the FAA safety approval process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43 and 44.

47. Page 79, Section 43 1.47, Denial of safety approval, Subpart D – Payload Reentry Review and Determination, last sentence:
Question: The proposed rule states that a summary determination can be requested by the developer if the risks to public safety posed by the payload were substantially similar to a previously approved payload reentry determination issued earlier to another RLV mission license applicant. How does the developer obtain this information? Is this a matter of public record?

48. Pages 80 and 8 1, Section 43 1.55, Payload reentry review:
Comment: Place a time limit upon the FAA payload reentry review process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track' for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43,44 and 46.

49 Page 8 1, Section 43 1.5 5, Payload reentry review:
Comment: This section refers to issues addressed by the FAA in a payload reentry review. Although the agencies to be consulted are identified, general information relating to reentry should be provided to the developer prior to the developer submitting the licensing plan and to the applicant (if not a developer) at the time of the request for application.

a. U. S. national security
b. U.S. foreign policy interests
c. International obligations
d. Other

In addition to these general issues, there will probably be concept-unique issues, which could not be addressed before submittal of the Licensing Plan by the developer.

50. Page 91, Section 435.23, Policy review requirements and procedures, Subpart C:
Comment: Definition of the safety evaluation process should be contained in the developer's Licensing Plan. This should be obtained from the FAA by the developer during preparation of the licensing plan.

51. Page 92, Section 435.35, Acceptable reentry risk for reentry of reentry vehicle, Subparts D and E:
Comment: These Subparts are currently blank. This information should be provided to the developer at a date sufficient for the developer to review before the NPRM review deadline.

52, Page 94, Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle, 1st and last para.:
Comment: The estimated average burden hours equate to ≈2.1man-years and seem low. If not already accomplished, the FAA should use the experience derived from certification of aircraft, not as a baseline, but as a reference point for determination of this burden rate. This information should be requested from the aircraft manufacturers, who should be pleased to provide the information. It is our opinion that the proposed burden would be several times greater than that proposed. Collecting of the historical data is essential to establish an initial baseline for RLV's. After collection of the historical data, it should be evaluated to identify the most critical elements affecting RLV licensing. This minimal data set can then be used to establish RLV history while minimizing economic impact upon the developer.

Regulatory Evaluation Summary

53. Page 95, Section 43 5.35, Acceptable reentry risk for reentry of a reentry vehicle:
Comment: Based upon the results of the survey of aircraft manufacturers proposed in item 52, the Regulatory Evaluation Summary may or may not be valid.

54. Page 96 Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle:
Question: The paragraph shows an estimated cost of $113 million dollars discounted to $65 million over a 15-year period, of which the commercial space launch industry would incur 27 percent. What ground rules and assumptions were used in this discounting?

55 Page 96 Section 435.35, Acceptable reentry risk for reentry of a reentry vehicle:
Comment: The $30 million figure distributed among 5- 10 developers is $3-6 million for each developer over a 15-year period for an average of $200,000-$400,000 per year. If this includes all costs for Licensing Plans, meetings, reviews, negotiations, etc. required for the initial development this seems low. Specific comments for each area are addressed under subsequent items. Reference item 52 for related comments.

Industry Compliance Costs

56. Page 98, Section 43 1.25, Application Requirements for Policy Review and Section 435.23 Policy Review:
Comment: The estimated cost for fulfillment of application requirements appears low for two reasons: (1) time per application and (2) loaded salary. Although it appears that much of the application information can be used as "boiler plate" for applications after the initial preparation, considerably more than eight hours could be consumed in preparation and

coordination. The hourly figure is probably low by a factor of 2 or 3. The loaded salary used is about $50 per hour. The average "wrap rate" for most aerospace companies is closer to $100 per hour. Combining the two factors means the cost per application is probably in the neighborhood of $1,600 rather than $400. On page 55, the NPRM states "The term of operator license would be set at a 2-year renewable period. Using the figure of $1,600 per application over the 2-year period equates to $800 per year or $12,000 per operator over the 15-year period. The total cost for all five operators would be $60,000.

57 Page 99, Section 43 1.33, Safety Organization and Section 435.25, Safety Review Requirements and Procedures:
Comment: Using a loaded salary of $100 per hour, which is characteristic of most aerospace companies, this estimate is low by a factory of two. The compliance cost will be about $200,000 per year for each operator or $15 million (5X $200,000 X 15) over the 15-year period.

58. Page 99, Section 43 1.3 5, Acceptable Reusable Launch Vehicle Mission Risk, and Section 43 5.3 5, Acceptable Reentry Risk for Reentry of a Reentry Vehicle:
Comment: The parameters used to develop these cost figures are not identified. It is assumed, however, that the same loaded salary was used for this as in previous calculations. This would indicate the projected costs are too low by a factor of two, equating to a cost of $1,600,000 per operator or $8 million for all 5 operators. Assuming the first year cost is based upon the same loaded salary, actual first-year costs would be approximately $ I .5 million. The estimated recurring cost of $3,600 annually equates to $54,000 over the 15-year period. Using the more realistic labor rate, the total cost would be $108,000. The relationship between recurring cost and term of the operator's license is unknown. If the $3,600 was developed by assuming a license term of 15 years instead of 2 years, amortizing the total cost over the 15-year period, the total recurring cost assuming a 2-year term could be 7X the more realistic cost or $756,000 per operator. If this is the case, the total cost could be as high as $11.3 million, consisting of $1.5 million first-year, plus $756,000 recurring for each operator times five operators. If there were no relationship between recurring cost and term of the license, total costs would be $8 million.

59. Page 100, Section 431.37, Mission Readiness and Section 435.33, Safety Review Requirements and Procedures:
Comment: Assuming the 80-hour preparation time is a reasonable number and the same labor rate was used as in previous calculations, this cost is also too low by a factor of two. This equates to a real cost of $8,000 per application, which is an annual cost of $533 per operator. If this requirement is related to the license term, the annualized cost could be 7.5 X as great for a 2-year term or $4,000 per year for each operator. This equates to $60,000 per operator for the 15-year period. Total cost for five operators would be $300,000. If there were no relationship between this requirement and license term, the total cost would be $40,000.

60. Page 100, Section 43 1.39, Mission Rules, Procedures, Contingency Plans and Checklists, and Section 43 5.33 , Safety Review Requirements and Procedures:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $180,000 over the 15-year period and a total cost of $900,000 for all five operators.

61. Page 101, Section 43 1.41, Communications Plan Section and Section 435.33, Safety Review Requirements and Procedures :
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $180,000 over the 15-year period and a total cost of $900,000 for all five operators.

62. Page 10 1 , Section 43 1.43, Reusable Launch Vehicle Mission Operational Requirements and Restrictions and 435.33, Safety Review Requirements and Procedures 2nd para.:
Comment: This paragraph refers to "limitations on dwell time over populated areas." This is clearly a new requirement not imposed by E,. For E_c calculations the Instantaneous Impact Point (IIP) is a continuously moving "footprint" along the RLV trajectory traversing continuously changing population densities. As noted in the NPRM, population density is multiplied by the casualty area of the vehicle to determine the consequence of a failure event. E_c does not include a time function. Although reason dictates that the risk of casualty is less over an area that is sparsely populated than one that is densely populated, it is impractical to assume that commercial operations will be performed only over sparsely populated areas. Should a catastrophic event occur on a large aircraft approaching a densely populated urban area, the probability of casualties is very great. However, aircraft are not prevented from using these airports because the perceived risk is low. This is primarily because the airline industry has been very fortunate that so few accidents have occurred over very densely populated areas such as apartment buildings, shopping centers and theaters.

It should be noted that if E_c calculations were performed for airlines, the E_c would be much greater over urban areas than sparsely populated areas just as for ELV's or RLV's. For takeoff and landing, risk to the population in the immediate takeoff and approach path is much greater for at least two reasons: probability of failure (P_f) is somewhat greater and the exposure time (or dwell time) is much greater. Takeoff and landing speeds for large aircraft are approximately one-fourth the cruising speed and, conversely, exposure time is four times as great. Therefore, although total risk to the population in the takeoff and approach path is significantly greater, E_c calculations are affected only by the P_f calculation. Dwell time does not enter the calculation. Since aircraft have no utility unless they can takeoff and land, this greater risk is accepted. The same philosophy should be applied to ELV's.

63. Page 103, Section 43 1.43, Reusable Launch Vehicle Mission Operational Requirements and Restrictions and 43 5.3 3 , Rest and Duty Restrictions:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $6.4 million over the 15-year period and the total cost would be $32 million for all 5 operators.

64. Page 103, Section 43 1.45, Mishap Investigation Plan and Emergency Response Plan, and Section 43 5.33 , Safety Review Requirements and Procedures:
Comment: It appears that this requirement is not associated with term of license. However, using the more realistic labor rate, these figures are too low by a factor of two. Assuming the time required is reasonable, the actual cost per operator would be $1,084 million over the 15-year period and the total cost would be $5.42 million for all 5 operators.

65. Page 103, Section 43 1.57, Information Requirements for Payload Reentry Review, and Section 43 5.43, Payload Reentry Review Requirements and Procedures:
Comment: This requirement appears similar to that addressed on page 98, Section 43 1.25. Similarly, the estimated cost for fulfillment of application requirements appears low for two reasons: (1) time per application and (2) loaded salary. Although it appears that much of the application information can be used as "boiler plate" for applications after the initial preparation, considerably more than eight hours could be consumed in preparation and coordination. The hourly figure is probably low by a factor of 2 or 3. The loaded salary used is about $50 per hour. The average "wrap rate" for most aerospace companies is closer to $100 per hour. Combining the two factors means the cost per application is probably in the neighborhood of $1,600 rather than $400. On page 55, the NPRM states "The term of operator license would be set at a 2-year renewable period. Using the figure of $1,600 per application over the 2-year period equates to $800 per year, or $12,000 per operator over the 15-year period. The total cost for all five operators would be $60,000.

66. Page 104, Section 43 1.73, Continuing Accuracy of License Application; Application for Modification of License:
Comment: This requirement appears similar to that on page 98, Section 43 1.25 and 435.23, however the numbers are significantly different. Moreover, the NPRM appears to assume that only one modification application would be submitted over the 15-year period. This is highly unlikely, since each operator would submit 8 applications during the 15-year period, it is not unreasonable to assume that one-half would require modification within the 2-year licensing term. This would increase the number of applications by a factor of four. The hourly rate is too low by a factor of two as explained in previous comments. Therefore, compliance costs would be $264,000 (2X4X$33,000) for each applicant or $1.32 million for all five operators over the 15-year period.

67. Page 104, Section 43 1.75, Agreements and Section 435.5 1, Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: The requirement to advise the FAA of compliance with the Federal range agreements may, indeed, require negligible effort, however the cost to the operator is dependent upon the means of notification. Paragraph 43 1-75(b)(2) needs to clarify the procedures or paperwork required by the FAA. There is clearly cost involved, which could be significant.

68. Page 105, Section 43 1.77, Records and Section 43 5.5 1 Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: It is assumed that the same labor rate was used for this estimate as for the others. Assuming the time estimate in the NPRM is reasonable, the actual cost would be $800 per entity per year. Over the 15-year period, the cost would be $12,000 (800X 15) per entity or $60,000 (5X$12,000) for five entities.

69. Page 105, 157 and 158 Section 43 1.79, Reusable Launch Vehicle Mission Reporting Requirements and Section 43 5.5 1 Post Licensing Requirements Reentry License Terms and Conditions (General):
Comment: The requirement to provide information addressed in paragraph 43 1.79(a) and (b) specifies two reports, one at 60 days and one at 15 days before launch. Pat-t (c) requires reports of accidents and incidents, Although this is a contingency, the time requirement could be significant. This paragraph needs to clarify the procedures and paperwork involved to provide this information to the FAA. Regarding the contingency reporting, it is suggested that some assumptions be made regarding frequency of occurrence – perhaps 5-8 reports over the 15-year period. There is clearly cost involved for parts (a), (b) and (c), which could be significant.

Paragraph 43 1.79 requires two reports, one not less than 60 days, the other not less than 15 days before each licensed RLV mission. A provision needs to be added to accommodate quick turn-around missions, e.g. - 3-7 days. Perhaps this could be accomplished with a detailed flight plan for planned events, but quick turn-around from an aborted mission also needs to be addressed.

70. Page 106 and 160, Section 43 1.93, Environmental Information and Section 43 5.6 1, Environmental Review (General) :
Comment: It is a well-known fact that attempts to comply with the plethora of environmental laws have killed many commercial projects. The FAA needs to become very pro-active in this area to prevent the death of RLV's aborning. Section 43 1.93 (a)-(d) identifies specific environmental requirements, however, part (e) states simply "other factors as necessary." There is insufficient time during the NPRM comment period to research the environmental laws in this area. In fact, it will take months to research this thoroughly and even then, miss a "killer" requirement, of which there may be many. It is worth repeating that the FAA, supported by Congress, must be very aggressive in this area.

The costs proposed in the NPRM assume a time requirement of 5,420 man-hours or approximately 2.5-3.0 man-years for each operator over a 15-year period, which equates to an average of less than 7 hours per week. The wording of Section 43 1.93 implies one reentry site. There is certainly a multiplier for this when multiple launch and reentry sites are considered. Considering the labor rate, multiple sites, and the uncertainties and unknowns, the estimate could be low by an order of magnitude. It is suggested that the estimate is too low by a factor of five. If this is the case, incremental compliance costs are probably much closer to $1.36 million per operator or $6.8 million for five entities over the 15-year period. The absolute minimum, using a realistic labor rate, is $542,000 per operator or $2.71 million for five entities over the 15-year period.

7 1. Page 106 and 162, Section 433.7, Environmental:
Comment: Using the logic addressed in item 66, this estimate is probably too low by a factor of five, if not an order of magnitude. Considerations include the labor rate, multiple sites and the uncertainties and unknowns. Incremental compliance costs are probably much closer to $810,000 per operator or $4.1 million for all five entities over the 15-year period. The absolute minimum, using a realistic labor rate, is $324,000 per operator or $1.62 million for the five entities over the 15-year period.

72. Page 106, FAA Administrative Costs:
Comment: Although industry comment may be inappropriate, it is suggested that FAA administrative costs will have a direct relationship to industry costs. Therefore, since industry costs will be much greater than that estimated in the NPRM, administrative costs will more likely approximate $166 million over the 15-year period, rather than the $83 million estimate.

73. Page 109, Benefits, (1):
Comment: The difficulty in determining economic benefits when human lives are at risk is understandable. However, the $30X10^{-6}$ number used as a measure of merit by the test ranges should be re-examined. This re-examination is, in fact, one of the follow-on action items identified by the RLV Working Group and it is presently in work.

74. Page 109, Benefits, (2):
Comment: The public expected casualty of $1X10^{-6}$ is much too stringent for application to the public adjacent to reentry sites. The same logic can be used here that was addressed in item 62. The fact that the exposure time is many times as great as the average exposure time and the population is expected to be much more dense near some landing sites simply compounds the problem in meeting this requirement. Although an allocation between launch and reentry risk needs to be made, the $1X10^{-6}$ number should also be re-examined. Since the expectation of casualty for launch and reentry is combined, the proper approach is to let the developer perform the allocation based upon the E_c criteria. This would allow maximum flexibility based upon the specific characteristics of the developer's concept, creating the most efficient regulatory approach.

75. Page 112, Benefits, last two sentences:
Comment: The calculation of costs on pages 96-108 appears reasonably straightforward The calculation of benefits, however, is extremely esoteric, determined as follows:

Step 1 identified (6) accident types grouped in (2) categories related to airborne explosions and ground point-of-impact crashes.

Step 2 assigned monetary values to each of the various types of accidents expected to occur during launch and reentry.

Step 3 assigned probabilities to each of the (6) accident types based on percentage of impacted landmass for the baseline and the proposed rule.

Step 4 estimated expected values for each accident type under the baseline and the proposed rule.

Step 5 calculated the expected benefit as the difference between the baseline and the proposed rule.

More information is required in terms of the specific numbers used for these calculations.

76. Page 112, Secondary Benefits:
Comment: Although the development process, without regulatory procedures, requires a great deal of paperwork, it is difficult to imagine that the additional paperwork required by the regulatory process could possibly result in enhanced operational efficiency which in turn should result in decreased costs. Exactly the opposite should be expected. It is a rather circular argument to state that secondary benefits would accrue due to enhancing efficiency because of clarifying regulatory and procedural processes which would not even be necessary were there no licensing process. These comments should not be construed as opposing the licensing process, rather a concern that the licensing process is represented as a cost saving to the developer or operator, which is an invalid assumption.

77. Page 113, Summary of Total Costs and Benefits:
Comment: The attached TABLE A summarizes costs addressed in items 52-67, pages 98-106. As the summary indicates, the estimated industry compliance costs obtained from the individual items are actually slightly more than $34 million instead of the $30 million shown in Table 1. Using the more probable labor rate of $100 per hour, the minimum most likely industry compliance cost will be $68 million. Using the other factors described in the individual items, the most likely industry compliance cost will be $78 million. Using the apparent discount rate of .554, the discounted costs are as shown:

Commercial Space Transportation Industry Compliance Costs

	Undiscounted	Discounted
FAA Estimate	$3 4 million	$19 million
Minimum Likely	$68 million	$3 8 million
Most Likely	$78 million	$43 million

Federal Aviation Administration Implementation Costs

FAA Estimate	$83 million	$45 million
Total Cost	$113 million	$65 million
Minimum Likely	$23 4 million	$128 million
Most Likely	$244 million	$133 million

78. Page 114, Initial Regulatory Flexibility Determination, 2nd pat-a:
Comment: The SBA has defined small business as entities comprising fewer than 1,000 employees. In fact, the five small, entrepreneurial businesses have fewer than 100 employees. Only two of those purporting to develop RLV's have an employee base approximating 1,000. In accordance with the cost assessment on pages 98-106, the total 15-year cost for five operators is estimated by the FAA to be $34 million, equating to $6.8 million per operator. As noted in Table A, the actual cost would be $68-78 million or $13.6 - $15.6 million per operator. Reference Item 77.

79. Pages 114-l 16, Initial Regulatory Flexibility Determination, 3rd through last para:
Comment: As noted above, the actual annualized compliance cost for each operator over the 15-year period is $907,000 - $1.04 million per year. The entire premise of RLV viability is based upon reduced launch costs. Although cost estimates between operators vary, it is not unreasonable to assume that RLV launch costs would be approximately one-half that of ELV launch costs. The NPRM also appears to assume that RLV's would capture the entire ELV market. This is surely not the case. It is probably reasonable to assume that RLV's capture one-half of the ELV market. When these two assumptions are combined, the average income per year for each of the five RLV operators is likely to average one-fourth that of current ELV operator income. Using a worst-case assumption of four launches per year, instead of the seven assumed in the NPRM, then $25 million per launch produces annual revenue of $100 million. Using the calculated compliance cost of approximately $1 million annually results in 1 .O percent of the anticipated annual revenue. It must be assumed that initial costs will be significantly higher than average cost over the 15-year period. Assuming initial costs are 2 times the average equates to $2 million annually. Assuming development time of greater than 3 years, equates to $6 million + during the development phase. This is during a period when there is no revenue stream. Based upon the previous calculations, a regulatory flexibility analysis may be required.

TABLE A

Proposed versus Actual Costs

Location	Estimate	Proposed Actual Min (1)	Most Probable (2)	Difference (1)	(2)
56, page 98, Costs	$ 2,000	$ 8,000	$ 60,000	$ + 6,000	$ 58,000
57, page 99, 43 1.33	8,000,000	15,000,000	15,000,000	+7,000,000	+7,000,000
58, page 99, 431.35	4,000,000	8,000,000	11,300,000	+4,000,000	+7,300,000
59, page 100, 431.37 435.33	20,000	40,000	3 00,000	+20,000	+280,000
60, page 100, 431.39 435.33	450,000	900,000	900,000	+450,000	+450,000
61, page 101, 431.41 435.33	450,000	900,000	900,000	+450,000	+450,000
63, page 103, Rest & Duty Restrictions	16,000,000	32,000,000	32,000,000	+16,000,000	+16,000,000
64, page 103, 431.43 435.33	2,700,000	5,420,000	5,200,000	+2,720,000	+2,720,000
65, page 103, 431.57 435.43	2,000	8,000	60,000	+6,000	+ 58,000
66, page 104, 431.73	165,000	1,320,000	1,320,000	+1,155,000	+1,155,000
67, page 104, 431.75 435.51	0		significant		+ significant
68, page 105, 431.77 435.5 1	30,000	60,000	60,000	+3 0,000	+3 0,000
69, page 105, 43 1.79 435.51	0		significant		+ significant
70, page 106, 431.93 435.61	1,400,000	2,7 10,000	6,800,000	+ 1,3 10,000	+5,400,000
71, page 106, 433.7	8 10,000	1,620,000	4,100,000	+820,000	+3,300,000
Total	$34,119,000	$67,986,000+	$78,220,000+	+ $33,967,000+	+$44,201,000+

Estimated Cost: $34,000,000

Summary of most probable cost: $68.000,000 - $78,000,000

80. Page 116, International Trade Impact Assessment:
Comment: The proposed rule probably has an effect upon international trade regarding operations from foreign soil. One example is that of U.S. companies opting to operate from foreign soil because of reduced risk. Some nations may require a less stringent expectation of casualty (E,) calculation than that required by U.S. federal ranges and the proposed rule. In others, the population density may be so small that the E_c prescribed by this rule can be met easily. In either case, it may be more attractive to operate from foreign soil.

81 Page 120, Section 400.2, Scope, last sentence:
Comment: Add to "40 1.5 Definitions" the phrase "Exempted-class rocket activities."

82. Page 12 1, Section 40 1.5, Definitions, Launch:
Comment: This definition should be revised, e.g. – last sentence should be changed to read, "Flight ends when the RLV touches down on the earth following reentry."

83 Page 122, Section 40 1.5, Definitions, Launch Vehicle:
Comment: Change "suborbital" to "sub-orbital."

84. Page 123, Section 40 1.5, Definitions, Operation of a reentry site:
Question: The definition states, "Operation of a reentry site means the conduct of safety operations. . . .". Are safety operations the only consideration for operation of a reentry site? Suggest the definition be changed to indicate a more general definition. Add the caveat that safety of operations is the sole consideration of AST if such is the case.

85. Page 126, Section 405.1, Monitoring of licensed and other activities:
Comment: After 1st sentence add the following: "Access to operator's facilities will be on a non-interference basis to the maximum extent possible."

86. Page 127, Section 405.5, Emergency Orders:
Comment: Last sentence is incomplete.

87. Page 127, Section 406.1, Hearings:
Comment: Paragraph (a)(1) is incomplete.

88. Page 139, Section 43 1.3 1, General, (c):
Comment: Place a time limit upon the FAA safety review process. Notification of issues should occur as soon as possible following identification (say, 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution that would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46 and 48.

89. Page 140, Section 43 1.33, c(l) and c(2):
Comment: These paragraphs address "dress rehearsals" and "mission readiness determination". These should be requirements only in special circumstances, e.g.-during the test flight phase or following a significant vehicle modification. The modification parameters requiring dress rehearsals, mission readiness determination and flight tests should be defined as a part of the Licensing Plan.

90. Page 140, Section 43 1.35, Acceptable reusable launch vehicle mission risk, (a), 2^{nd} sentence:
Comment: Sentence states "...mission commences upon initiation of launch phase of flight, ..". However, on page 12 1, Launch, 2^{nd} and 3^{rd} sentence state: "The term launch includes the flight of a launch vehicle and pre-flight ground operations beginning with the arrival of a launch vehicle or payload at the U.S. launch site. Flight ends after the licensees' last exercise of control over its launch vehicle." It is probably not the FAA's intent to include all pre-flight ground operations in the mission risk calculation. Change to read, "... mission commences upon initiation of the vehicle launch countdown,..." or something similar.

91 Page 141, Section 43 1.3 5, Acceptable reusable launch vehicle mission risk, (b) (1) and (2):
Comment: The expectations of casualty $30X10^{-6}$ and $1X10^{-6}$ were addressed previously under items 73 and 74.

92 Page 146, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (c) (2):
Comment: Paragraph (c) (2) states " substantial dwell time over densely populated areas...". The term "substantial" must be defined, either specifically or by providing criteria for calculation.

93 Page 146, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (c) (3):
Comment: Paragraph (c) (3) states "There will be no unplanned physical contact between the vehicle or its components and payload...". This is like the old joke directive "There shall be no more mid-air collisions." Change to read, "The method of payload separation shall ensure no contact between the deploying vehicle and payload following separation and shall not generate debris that could damage the deploying vehicle or its payload," or something similar.

94, Page 147, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (d) (1):
Comment: Same as comment 92. Define "substantial."

95. Page 147, Section 43 1.43, Reusable launch vehicle mission operational requirements and restrictions, (d) (2):
Comment: Paragraph (d) (2) states, ". . . given a probability of vehicle failure equal to 1 (p_f = 1) at any time the IIP is over a populated area;" As noted previously, the assumption of p_f = 1 is overkill and should be re-examined. The term "populated" needs to be defined in terms of population density. Reference item 26.

96. Page 149, Section 43 1.45, Mishap investigation plan and emergency response plan, (c):
Comment: Add "(MIP)" after "mishap investigation plan."

97. Page 150, Section 43 1.45, Mishap investigation plan and emergency response plan, following (c) (9):
Comment: Add (c) (10) "A MIP shall be submitted as part of the application process."

98. Page 149, Section 43 1.47, Denial of safety approval, 1st sentence:
Comment: Place a time limit upon the FAA safety review process. Notification of the denial of safety approval should occur within that given period. There shall also be a "fast track' issue for resolution, which would not require another complete review. It should address only those item(s) for which safety approval was denied.

99. Page 15 1, Section 43 1.53, Classes of payloads, (a):
Comment: Paragraph (a) states, "The FAA may approve ", Change "may" to "must".

100 Page 152, Section 43 1.55, Payload reentry review, (e):
Comment: Place a time limit upon the FAA reentry review process. Notification of issues should occur as soon as possible following identification (say 5 working days) but no later than the end of the review period. There should also be a "fast track' for issue resolution, which would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46, 48, and 88

101 Page 152, Section 43 1.59, Issuance of payload reentry determination, (a) 2nd sentence:
Comment: Same as item 100. Place time limit upon review.

102 Page 155, Section 43 1.73, Continuing accuracy of a license application; application for modification of license, (e):
Comment: Place a time limit upon FAA license modification review. Notification of issues should occur as soon as possible following identification (say 5 working days) but no later than the end of the review period. There should also be a "fast track" for issue resolution, which would not require another complete review. It should address solely resolution of the specific issue. Reference items 43, 44, 46, 48, 88, 100 and 10 1.

103 Page 157, Section 43 1.79, Reusable launch vehicle mission reporting requirements, (a) and (b):
Comment: Same as item 69. Need to address quick turn-around.

104 Page 157, Section 43 1.69, Reusable launch vehicle mission reporting requirements, (c), 1st sentence:
Comment: Sentence states, ". . . or other mishap immediately." Define the term "immediately," possibly "within 24 hours," or something similar.

105 Page 158, Section 43 1.83, Compliance monitoring:
Comment: Sentence states, "A licensee shall allow access by.. . " Add the qualification, ". . . on a non-interference basis to the maximum extent possible." Reference item 85.

106 Page 164, Section 435.3, Types of reentry licenses, (a) Reentry specific license:
Question: When an expendable upper stage is used with a reusable first stage, does the launch license include authorization to de-orbit and reentry the upper stage? If not, it should.